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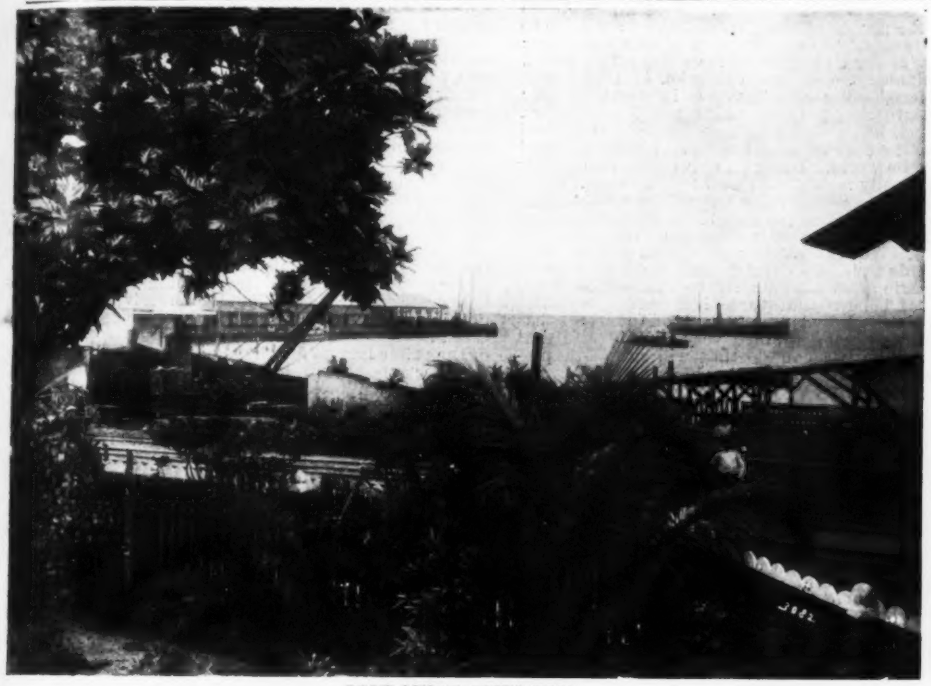
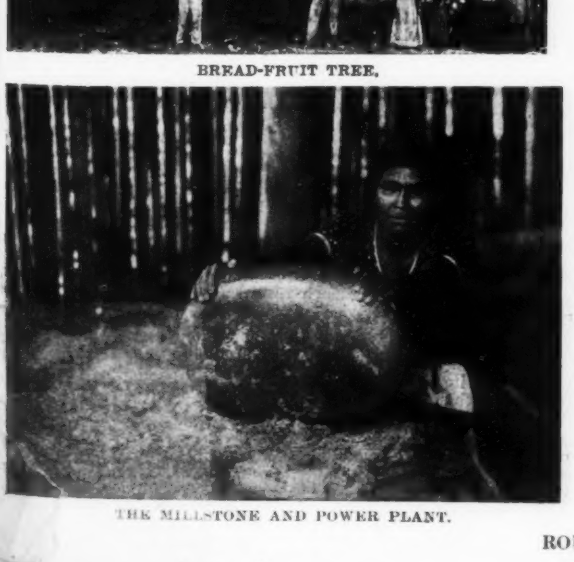


PORT LIMON, COSTA RICA.

CUT IN EARTH AT LA JUNTA ON THE COSTA RICA RAILROAD. SHOWS ALMOST VERTICAL SLOPE.

BREAD-FRUIT TREE.

NATIVE GROUP, WITH THATCHED HUT AND CACTUS HEDGE.



THE MILLSTONE AND POWER PLANT.

TELEMANCA MOTHER AND CHILD.

WASHING SCENE, COSTA RICA.

ROUTE OF THE NICARAGUA CANAL.

THE NICARAGUA CANAL.*

By Prof. LEWIS M. HAUPT, C.E., Member of the Nicaragua Canal Commission.

I HAVE accepted the invitation of one of your members to address you this evening on a subject which I consider of supreme importance to the welfare of the United States. I have departed from my usual custom, to decline all such invitations, because it is one of so great importance, and I feel that the position of affairs at the present time is a critical one; and, therefore, I have improved the opportunity of coming before this large and intelligent audience to give you some little idea of the situation.

The problem is one of so great scope that it is difficult to do it justice in the short time allotted to a speaker in an evening. It may be considered from a great many standpoints: We may consider it from the economic standpoint, or from the physical, or from the engineering, from the financial, or from the commercial, from the strategic, or from the diplomatic; and all these have certain relations to one another; but there are a few of them which I wish to develop a little in order that we may understand more fully their relation to the problem.

It seems to me, at the present juncture, it is most important for us to confine ourselves to the strategic-commercial position of the canal and its influences or effects upon the commerce of the world. There is no enterprise, no possible engineering work, in my mind, that will do so much to develop the commercial and industrial interests of the world, and to extend its civilization, as the construction of this highway connecting the Atlantic with the Pacific.

To understand fully its strategic relations, it is necessary for us to review the history of the effort to open this highway. It is well known to you that for about four centuries an effort has been made to discover the secret of the straits; and that nearly all European nations have sent expeditions and explorations to this isthmus for the purpose of discovering, if possible, a shorter route to the East Indies. Many of these resulted in failure and great distress; and though, for at least seventy-five years, the United States has taken a very active part in these explorations, though there have been at least sixty expeditions and routes surveyed across the isthmus connecting North and South America, up to the present time, we have not passed beyond the first stage of development, which is the stage of education and popular discussion; the second stage being that of construction, and the third stage that of fruition. These two stages are still in the future, and it depends very largely upon ourselves as to when they will be reached; and it may be well for us to consider why it is that so long a time has elapsed before active construction work has begun.

In all great public works there are always obstacles; and the most serious obstacles are usually not the physical but the social, and those resulting from vested interests; and so we will find in this case, as in others, that there are certain interests which may apparently be interfered with by the opening of such a waterway, and that these interests are naturally antagonistic.

Among the objections which have been urged to the construction of this canal are; first, the physical difficulties which lie in the way of the construction of such an enterprise, the earthquakes and the volcanoes which are found to exist in tropical countries. There are also engineering difficulties which have been very greatly magnified and misstated. It is stated, also, that the United States ought not to go into partnership with any private parties for the purpose of opening this canal. That the concessions which the present Maritime Canal Company have are held by private individuals, for a speculative purpose, and that the company is attempting to unload on the United States for a very large bonus. Those are mere pretexts, of course, for the purpose of postponing, or deferring, action upon this great project. The United States can scarcely assume the position of taking possession of the work done by private parties for public uses without just compensation, so that no bill which does not recognize the labors of the canal company and does not properly compensate them, could be considered equitable.

It is also urged that there would be no commerce through such a canal if one were built. That is a very complicated question, and one we have not time to consider this evening; but there is very little ground for such statement. If you look at the history of the development of our own waterways, you will immediately find an answer to such an objection.

It is also urged that it would not pay. That will depend very largely upon the amount of commerce and the tolls charged for its transportation. It is stated, also, that the concession of the Maritime Company will expire in October, 1899. That may or may not be true. The Nicaraguan government has declared, by an action of its congress, that the concession will expire at that date. That is a legal question, however, which is susceptible of various constructions. Upon that basis an option for a concession has been granted to another syndicate, which has recently been formed in New York, known as the Eayer-Cragin syndicate, which has only an option with Nicaragua and none with Costa Rica. I mention it only as a factor in the critical conditions confronting us. There is, also, another concession which would take precedence of that option, and that is the one given to the Atlas Company, an English company claiming the right to the exclusive navigation of the San Juan River, and to the construction of portages over the rapids in that river; so that at the expiration of the concession granted under the Menocal-Cardenas agreement, this English concession may take precedence of the first ones, and would involve us in further diplomatic difficulties with foreign countries. Again, it is urged that the Panama route will suffice for every practical purpose, and that it is now under proper engineering management and good supervision and will be completed for a reasonable sum, and in a reasonable time; and that there is no use for two canals on the isthmus. It was also said that if the Nicaragua Canal were built, some dynamite fiend might go there and destroy the locks and ruin the canal. That will apply to every public work in the world.

Another very serious objection is that it would interfere with and interrupt, to some extent, the business of the transcontinental railroads; and that question I would like to develop a little more fully at a later moment. It is said, also, that it would disturb foreign trade relations. That is true, and that is another important consideration as a reason why this canal has so long been delayed. It has been estimated that the construction of this canal would economize for the commerce of the world not less than $420,000,000 annually. On this basis you will see that the cost of the canal is comparatively insignificant. If it cost only $100,000,000 to build and saves $420,000,000 a year, there is a raison d'etre.

Summing up these objections, we find that they are based generally upon jealousy, avarice, and vested right, the same principles which underlie the obstruction urged to every great public improvement of any kind, as shown by the history of the development of the world. Now what are the forces in favor of the construction of this canal? Your presence here on this inclement night is a very striking illustration of the fact that the people of the United States are alive to the importance of the construction of this waterway; the people of the United States, we may safely assert, are unanimously, with the exception of those mentioned before having certain vested interests, in favor of the construction of this canal by the United States, to be owned, controlled and operated by the United States, for the commerce of the United States, as well as that of the world. We may also count on another force not usually reckoned in works of this class. There is a Providence which rules the affairs of men and which applies to nations as well, as we have seen in the events of the last year with reference to our own development. We can safely count upon the hand of God to guide us in the development and extension of our civilization and Christianity to the nations of the East; and I believe that there is a certain, manifest destiny for the United States to work out, and that that destiny is being fulfilled very rapidly, and that there is nothing we can do that will so greatly promote that interest as the opening of this canal. It was said by King Philip of Spain, about three centuries ago, that the barrier which existed at this isthmus was placed there by the Lord for the very purpose of preventing the connection of these two oceans. This obstacle furnishes man with an opportunity for developing himself and displaying his resources.

These, then, are the forces arrayed on opposite sides, against, and in favor of, the construction of the canal; and "He that is for us is greater than he that is against us;" therefore, I think, we may safely hope and pray for the construction of the canal at an early date.

With reference to the policy of our commercial rivals on the other side of the ocean, we find, if we look into the history of the maritime powers of the world, that there has been a gradual progression of the maritime strength of the world from the eastern end of the Mediterranean, in fact, from the time of the Chaldeans, westward through the Phenicians, the Venetians, the Portuguese, and Spaniards, until now England is supreme as a maritime nation, and it is the power—the sea power—of England which has made her what she is. When we consider that here is a group of islands, covering about 120,000 square miles, and having a population less than one-half of ours (40,000,000 only), and that they control a population of 322,000,000 peoples—dependencies—or, in other words, one English person controls eighty foreigners, it shows us the immense power of the intelligence and Christian development of that nation and government through her sea power. As we go on this evening, I will show some of the outposts of that civilization on the screen. Until within the last year the United States has had no such outposts. Recently we have acquired a few of them, and their importance as strategic positions for the development of commerce and civilization is great.

As early as 1727 the Treaty of Paris was passed, when England and Holland formed an alliance to prevent the Austrian Netherlands from having any trade whatsoever with the East Indies; and by a royal edict it was prohibited that the Austrian Netherlands and the Indies should have any communication with each other, in either direction. As early as 1698 a Scotchman named Robinson formed a colony and settled on the Isthmus of Darien. He was not supported, however, because of the fear that it would interfere with the trade of the East Indian Company, so that he was driven off afterward by the Spaniards.

Again, we find, with reference to the history of the Suez Canal, which is very pertinent as bearing upon the construction of the Nicaragua Canal, that the policy of England before the opening of that canal was extremely hostile. The prime minister, in 1857, stated his reasons for his opposition, publicly. Robert Stevenson, the great railroad engineer of England, reported that the canal was impracticable and that he was against it. The sentiment of many other Englishmen, as well as of the press, was hostile. The Edinburgh Review said it was utterly impracticable and urged that the available resources of Egypt could not execute such a work in a hundred years; that the cost of maintenance would equal the original outlay; that vessels would have to be paid to induce them to patronize it, if built; that it ought to be an interesting question to discuss, but would hardly ever benefit mankind. In the light of the experience of the past years, we can see how much weight to attach to these objections, which are being repeated in the objections urged against the Nicaragua Canal. The Quarterly Review followed in the same strain, believing the scheme to be commercially unsound. England did not contribute anything to the building, but has since been the largest patron and greatest beneficiary in its operation. It paid $19,000,000 and over for a certain number of shares (176,000 shares), and that same property is to-day worth $123,000,000. An English author, in referring to this condition of affairs, recently said, "No one could at that time have foreseen that in less than thirty years from that date the Suez Canal would have become an accomplished fact and would have become, perhaps, the most successful enterprise of modern times, that it would have revolutionized our shipping and transit trade, that our Indian and transient trade would have participated in its advantages to an enormous degree."

A large portion of that canal was built by Arabs carrying the earth in baskets on their backs and on their heads. The total cost of the canal is reported to be about $100,000,000; but the actual cost of construction was probably nearer $60,000,000, the rest going for interest and for financing, and various other purposes. The experience there was somewhat similar to Panama in its earlier stages. The Suez traffic exceeds the most sanguine expectations. It is now over 9,000,000 tons; and the canal is paying, regularly, at least 13 per cent. dividends; it has paid as high as 23 per cent. dividends; so that all the prophecies which have been made in regard to this canal have been completely destroyed and the canal has more than verified the most sanguine predictions of its promoters.

There are a great many phases of this question, as I have stated. I will not detain you to discuss them too fully, verbally; otherwise I am afraid the part which will be more interesting to this audience will have to be curtailed; but I would like to refer, only incidentally, to the opposition of the transcontinental railroad lines and to say that, after considerable research and study upon that particular branch of the subject, I feel very firmly convinced that there is nothing that could be done that would so greatly promote the business of the transcontinental railroads as the opening of this canal. Naturally, it looks like a division of tonnage and seems to be a paradox; but such is not the case, for the history of railroad development in this country has shown that wherever there is a cheap waterway competing with a railway, that railway is generally in excellent financial condition; and the railroads in this country paying the largest dividends and whose stocks stand highest in the market are those having such deep water competition. If you will look over the stock quotations, you will find that those railroads which are geographically situated along a seaboard or which parallel a deep water lake, a navigable river, or a free canal are those which are doing the best business; while those running through interior territory, between large terminals, are usually below par, or are in the hands of receivers. There is nothing that will do so much to colonize the Pacific Coast as the opening of this canal; and as that is one of the prime factors for the development of railroads, the effect upon the railroads will be very great and in a short time I believe their tonnage will be at least doubled.

With reference to the status of legislation on the question, I need only call your attention to the fact that the Morgan bill, which has recently been passed and which has been referred to the Interstate Commerce Committee, is under consideration by that committee in connection with several other bills originating in the House. One known as the Hawley bill is substantially the same as the one passed by the Senate. There are several other bills in the House; but some of them look toward the procuring of a sovereign right first before taking any further action; but as this requirement would violate one of the stipulations of the Clayton-Bulwer treaty, it would throw the whole question back into the field of diplomacy, and "it may be for years, or it may be forever," before the United States will secure control of that canal, because the same conditions will continue to surround the atmosphere of the canal which have prevailed for so many years past. Therefore, the time is extremely critical, unless Congress acts before the expiration of the present option.*

* Digest of a lecture delivered before the Friends' Institute Lyceum, Philadelphia, February 3, 1899. Revised for the SCIENTIFIC AMERICAN SUPPLEMENT by the author.

* Subsequent to the delivery of this lecture Congress authorized the President to appoint a commission to examine all possible routes for a canal, including that at Panama, and voted $1,000,000 for the purpose.

AN ENGLISH REVIEW OF THE SPANISH-AMERICAN WAR.

THE hostile operations between Spain and the United States, considered as a war, have not afforded many practical object-lessons to the naval strategist. It is a matter upon which we have mixed feelings. Object-lessons in war cannot be learned without much letting of blood on both sides; therefore, as simple humanitarians, we rejoice that so few lessons were learned during the late warlike operations; it would be almost too much to call them "war;" there was so little hitting back by one side. But our humanitarianism, like most of our qualities, good or bad, is compound rather than simple; so, with a balance of feeling in favor of our own countrymen, we would like such military object-lessons as may be needed by mankind to be paid for by the blood of others rather than by our own. If, however, we put aside our war standard, and compare the amount of instruction received on a peace basis—as represented by naval maneuvers, theoretical disquisitions, or that most problematical of guides, the war game—we find a wealth of instruction; enough to keep our naval strategists and tacticians busy for the next year or two, showing the results of the war to be proof of the soundness of their own special theories.

War has its consolations, just as peace has its victories, and they come to the warrior oftener than to the citizen. Among those to whom the Spanish-American war—for we must perforce give it its courtesy title—has brought most consolation, as a set-off against the inevitable unpleasantness of fighting, is no doubt Admiral Colomb. He is, every one knows, as amiable and gentle a sea warrior as ever longed to blow a ship's company into eternity, but before the war had progressed far he made some remarkably shrewd forecasts of what should happen, and, to his great glory and satisfaction, now that the war is over, it is seen that things should have happened just as he foretold. That they did not, exactly, is beside the mark. The principles were sound, and if events did not justify them, that must be laid to the blame of events. In all seriousness, however, it may be said that the Spanish-American war has shown the soundness of the views that Admiral Colomb has put forward with so much perseverance through many years past. Years before Captain Mahan wrote, he industriously preached the great doctrine of naval supremacy and the futility of military preparations—more especially in the form of fixed defenses—unless supported by adequate naval force. He showed the small fear we need have of invasion so long as there was a "fleet in being," and impressed the wisdom of sending our fleet anywhere to seek an enemy's ships rather than keeping in home waters; or, in other words, that the best protection for our coast was to seek out and destroy the fleets of the enemy, all other operations being subsidiary to this first need for our existence as a great power among nations.

At the present time these principles have become

almost truisms in the popular mind, and the navy now receives the consideration it merits, and which expediency demands for it. This sounder policy is largely due to Admiral Colomb: far more so than the general public appreciates. If, as some think, he has occasionally overshot the mark in the enthusiasm of advocacy, his main contention has been sound, and the thanks of the country are specially due to him for his untiring and disinterested labors. On Wednesday, March 8, he contributed a paper to the Royal United Service Institution, in which he set forth some of "The Lessons of the Spanish-American War." Perhaps, some critics may be inclined to say, one of the most remarkable of the "lessons" is that Admiral

THE TELEMANCAS AND CHIEF.

The chief stands by post with his hands on a child.

Colomb has learned there may be some virtue in a fixed defense. He speaks of the difficulty of grappling telegraph cables in deep water, and says: "The lesson appears to be that it is not impossible that if we were at war, attempts might be made to damage us in that way (i. e., by cutting our cables in shallow water); and it seems a legitimate conclusion to assume that the ends of our cables ought to be covered and protected by a few of the longest-ranged guns properly mounted in a battery."

Admiral Colomb holds that the proper strategy of the Americans was to send a sufficient force to the coast of Spain. "The seizure of Minorca as a base would," he says, "probably have been an easy operation; and in any case it would have been morally certain that if this action had been taken, nothing offensive on the other side of the Atlantic could have been thought of by Spain. Then for Cuba and Porto Rico, landings for conquest might have been effected at leisure." Unhappily for the Spaniards, "nothing offensive" was possible on either side of the Atlantic with their ill-served and ill-fitted ships, but that, of course, was not known at the time. The strategy Admiral Colomb advocates, supposes that America possessed a sufficient fleet to seal up the Spaniards in their ports, and also a surplus of ships capable of destroying any vessels Spain might have sent to West Indian waters; and which might have constituted "a fleet in being" absolutely forbidding—according to Admiral Colomb's own teaching—any operations of the nature of landing troops. That consideration, however, does not affect the wisdom of seeking the enemy's ships wherever they might be, so far as strategy was concerned, but probably political considerations had weight in this connection, as the author suggests. In regard to the efficiency of "the fleet in being," it may here be said that Admiral Colomb holds that "whatever the restraining power of 'a fleet in being' might be, when fleets moved according to the wind, it would be enormously increased by the employment of steam propulsion."

The author of the paper condemns "the sort of panic" that reigned all along the Atlantic coast of the United States, because Admiral Cervera was at sea, and no one knew where nor when he was likely to turn up. He says:

"I wonder how much money was wasted in preparing by means of fortifications and submarine mines to meet—not to prevent—attacks that were least likely of all the possibilities of war. We have heard of the inconveniences suffered from the presence of submarine mines in the American ports, but we have yet to hear of the little annual bill which will for years be presented for the scheme of local defense of the American coasts, which it seems is certain to be adopted. . . . As long as we look at things from the side of the defenders, it seems the most reasonable thing in the world to close the harbor of New York by submarine mines, batteries, and what not in war time, lest an enemy's squadron should come inside and bombard the city. . . Naval commanders will run into considerable dangers in order to get at ships. But towns are not their business. If towns are to be attacked, there will be a landed army and all things regular. No naval officer with his hands free would, in war, proceed into New York Harbor in order to damage New York, even if he believed there were no batteries and no mines to prevent him."

GROUP INCLUDING ADMIRAL WALKER, ENGINEER MENOCAL, PRESIDENT ZELAYA, OF NICARAGUA, AND VARIOUS CHICAGO VISITING ENGINEERS AND CAPITALISTS.

Of course the views of Admiral Colomb, and those who think with him, as to the assured immunity of towns and cities from attack by hostile craft, are challenged by a large number of authorities; and certainly an influential school among Continental strategists hold that a cause may be helped by operations of this nature, which they will not scruple to undertake. Even in this short war we find an instance of the value of such a power, when Admiral Dewey silenced the batteries at Manila by a threat of bombarding, not the batteries, but the town, if his ships were molested. If such a concession could be obtained, why not others? Doubtless the ultimate issue of a war could not be determined by occasional bombarding of coast towns and ports, but the experience would be very unpleasant while it lasted.

After all, this question of ship defense or fixed defense is a matter of cost. A ship is better than a fort because of its mobility. Very true; but those who tell us this also tell us we have not ships enough. If we ask "Why?" we learn that it is because ships cost money, and we spend all the taxpayer will find; in short, money is the limiting condition. Now, to bottle up and blockade the fleets of our enemy we need three ships for every two bottled up; and if we take a very possible alliance against us, we find little more than a balance of vessels between ourselves and our opponents. This brings about a condition of a number of unbottled ships of our adversary free to carry out their avowed intention of preying on our commerce or bombarding our defenseless coast towns. Still looking at the matter from an economical point of view, how are these towns best protected? They lie at a distance of every few miles all around the English coast. There may be twenty unbottled cruisers of our enemy, and it might take two, or perhaps three, forts to keep them at a harmless distance from any one town. Each town must have its own fort or forts, and there are more than twenty towns. The question then arises, Would it be cheaper to build thirty more ships to bottle up the enemy's twenty, or to construct forts sufficient for defense of all the towns?

Forts are certainly cheaper than ships, and they cannot be sunk, but then ships can go out and sink other ships, which forts cannot do, therefore the enemy's vessels always remain as a menace, so far as the forts are concerned. Mine fields are of very limited use. They cannot be extended indefinitely, and modern naval guns are effective at long ranges. It is not very likely that an enemy's ship would venture far into inland waters while there was a possibility of a superior force catching him in the trap. The bombardment of London, or even Gravesend, would presuppose the loss of the sea to us, and in that case fixed defenses would be of small avail. There is, however, the important consideration of the defense of our oversea commerce, and that needs ships, not forts, although certain defended positions would be desirable for merchant ships to make for at need.

As we have said, the problem is one of finance, and we trust it has been duly worked out by our intelligence departments. It is to be feared, however, that each branch of the service thinks so exclusively of its own function that no combined effort of this nature has been attempted. This aspect of the question is one of the first importance, a fact that was illustrated during the late war, when the Americans, almost unopposed as they were, suffered considerably by the lack of cohesion between the naval and military branches. The respective values of forts and ships should be doubtless settled by compromise. Admiral Colomb himself points out the protection and assistance that forts can afford to ships; and where such cheap auxiliaries to the navy can be made effective, it would be foolish to neglect them. The need of safe havens in which ships can refit, or in which they could take refuge in the face of superior force, are among the foremost teachings of history, but to hope to put it out of the power of hostile vessels to hurt us anywhere simply by fixed defenses is beyond hope. After all, if we go to war, we must take our chance of being hit, and the craving for absolute safety is not one that can be satisfied.

The absence of torpedo operations was a feature in the war that caused a good deal of surprise to many people. The Americans made so much use of the torpedo in their own civil war—considering, that is, the very imperfect state of its development at the time—and the weapon seemed so fitted for the ingenuity and mechanical audacity of the race, that we fully looked forward to some new and diabolical departures in this field. As a matter of fact, however, the American navy had nothing very effective in the way of torpedo craft, and the "Vesuvius," with its dynamite gun, which was to have worked such wonders, proved comparatively a failure, so far, at least, as rendering efficient aid to the fleet was concerned. The Spaniards, on the other hand, possessed some fast and well-equipped vessels; but these, like the rest of the Spanish fleet, had been allowed to fall into such a deplorable state that probably little could have been expected from them had they had the chance of operating.

Admiral Colomb refers to the danger from conflagration resulting from shell-fire. Since the battle of Yalu this lesson has needed no enforcing for those who will take the trouble to read plain facts. Admiral Colomb agrees with the late Admiral Sir Cooper Key, who thirty-three years ago said that the danger from fire, through the bursting of shells, even in wooden ships, was not great. It was not that fires would not be started, but with well disciplined crews they would be taken in time and easily subdued. It is the case over again of "the carpenter's cap being the best fire extinguisher in a theater," and Admiral Colomb rightly says it is a question of men rather than materials. Still it is wise to reduce combustibles on a warship to the lowest limit, either by treating wood chemically or by substituting metal for it. This is an important point we shall return to again. The admiral does not approve of the present arrangements for pumping service or fire service in our ships. He has "never reconciled himself to the main drain, nor to the main fire service of pipes," but is more inclined to the isolation of compartments; "feeling that in one case there would in emergencies be an unexpected flooding of compartments supposed

to be cut off, and in the other a breach of continuity in the water pipes." When he had to consider the matter formerly, however, he could see no alternative, but now he is of opinion that "the dynamo, the motor, and numerous alternative electrical communications offer conveniences for isolating compartments as to pumping and flooding service."

There is one other point that we will mention before closing our notice of Admiral Colomb's valuable paper; a contribution which will be printed in full in the Journal of the Royal United Service Institution, where all interested in these matters should refer to it, as we only touch on some of the most salient features. The remaining point is the effect of gun-fire on the thickness and disposition of armor, the question arising in connection with the risk of conflagration through shell-fire. A theory largely held was, and doubtless is, that no armor was better than thin armor, as shells would go through unprotected sides and thus right through the ship without bursting; but if there were even thin armor, the resistance would be sufficient to cause the shell to explode. This resulted in a small area of very thick armor and a very large area quite unprotected. In reference to this Admiral Colomb says that:

"Experiments undoubtedly showed that projectiles which penetrated armor, especially if they broke up, created much greater interior havoc than such as passed clean through thin plating intact. Hence the argument was, that there should be no armor except such as would stop everything, and that otherwise everything should be allowed to go through. The logic was sound enough if it could be guaranteed that the enemy would only fire heavy projectiles. But as the policy left 3-pounders effective, it was inevitable that they would be effectively used. To me the real point was a balance between the gun and the armor. If the balance were to be drawn at 3-pounders, it was still a balance, so that the loss due to letting 6-pounders through was compensated by the gain of keeping 3-pounders out; or if the balance were to be drawn at 6-pounders, then the loss due to letting 12-pounders through was compensated by the gain of keeping 3-pounders and 6-pounders out, and so on."

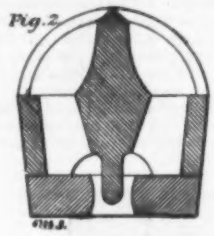
The reasoning here is quite sound in principle, the difficulty of course lying in balancing the chances. It should, however, be remembered that when the "Inflexible" was designed—which ship the author refers to as being inferior in her system of armor to the original "La Gloire" and also to the "Achilles" and "Minotaur"—the principal armament was almost the only armament, and it is the wonderful growth in the efficiency of secondary armaments which has caused designers very logically—and often very courageously—to alter their plans and adopt a system that may have been premature at the time it was first suggested. The earlier ships manned had to be armored to meet what was practically wholly a secondary armament, and now that secondary armament is once more to be in the ascendant, we have a return to the older conditions. —Engineering.

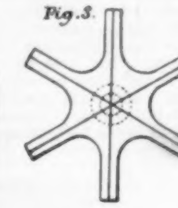
THE PRODUCTION OF METALLIC TUBES BY EXTRUSION.

AT the spring meeting of the Iron and Steel Institute in 1896, a paper was read by Mr. Perry F. Nursey describing the process of, and the machinery for, manufacturing metallic bars of any section by extrusion at high temperatures. This system is the invention of Mr. Alexander Dick, and by it all kinds of metallic sections are produced, from a simple round wire to complex designs with re-entering angles, which it would be impossible to roll, by forcing metal, heated to plasticity, through a die under hydraulic pressure. These sections are all solid, but since the reading of that paper, which was published by us at the time, Mr. Dick has made the important discovery that copper and its alloys in a heated and plastic condition can be separated, and, provided no air has access to it to oxidize the fresh surfaces, they will reunite by simple pressure. A true weld is thus formed which it has been found impossible to rupture. Upon this discovery Mr. Dick has founded and perfected a system of producing metallic tubes of any section by the same process, and their manufacture is now being carried on concurrently with that of the solid sections. Of course we do not overlook the fact that the principle of extrusion has been applied in the production of leaden pipes and leaden rod for the manufacture of projectiles for small arms. But, in those cases, the lead is pressed at a comparatively low temperature, while in the present instance the metal has to be operated upon at a very high temperature, namely, that of plasticity or about 1000° Fah.

The process of manufacture is carried on by means of a press, of which we give a perspective view in Fig. 1, which is taken from the rear or power end of the press. The machine is 16 feet in length, 6 feet wide, and 5 feet high over all. It consists mainly of the compressing cylinder or container and the hydraulic ram. The heated metal is placed in the cylinder, at one end of which is the die, and upon pressure being applied at the opposite end the plastic metal is forced through the die, issuing therefrom as rods, or as tubes, of the required section and of a length governed by the quantity of metal placed in the container. This container has not only to withstand the high temperature of the metal, but it has also, while under the influence of that temperature, to meet the severe strain brought upon the interior by the resistance of the metal to the pressure of the hydraulic ram in forcing it out through the contracted area of the die. The construction of the container was, therefore, an anxious matter, and the designing of it gave some trouble, but at length all difficulties were overcome and every working requirement amply met. The container, which is 2 feet long and 2 feet in diameter externally, has an inner liner of cast steel. The internal diameter of the liner varies in different containers from 5 inches to 8 inches, according as to whether it is wanted for pressing a small or a large charge, the container being changed as required. The liner is inclosed within a series of cylinders of ordinary mild steel spaced about ¾ inch apart, the annular spaces being filled in with a nonconducting material composed of crushed granite mixed with a small proportion of borax. The container is mounted on trunnions and fitted with worm-gearing for bringing it to a vertical position for being charged with metal and restoring it to the horizontal for the operation of pressing.

The die plates are made of tungsten steel, and they are formed with either one or several openings, each





opening being, in the case of rods and bars, of the section required to be given to the article produced. In the case of tubes there is a mandrel in the center of the opening in the die plate. This form of die is shown in Figs. 2 and 3, Fig. 2 being a vertical section and Fig. 3 a plan view at the back of the die, or that portion which presents itself to the incoming metal in the operation of pressing. Upon the plastic metal meeting the sharp edges of the ribs or wings of the die, the stream becomes divided, and is conducted in several streams to the mandrel, around which the incoming metal is pressed. Here the divided streams of metal are reunited as a tube, and become firmly welded together, so that it is impossible to discover the points of junction in the finished tube. This reunion is dependent upon the exclusion of the air, which would otherwise cause oxidation of the surfaces of the metal, and prevent them uniting. A singular verification of this is shown by the fact that for a few inches at the front end of every tube the metal is never united, as will be seen from Fig. 4. It might be thought that this was due to the cooling action of the die on the metal. This, however, is not the case, inasmuch as at the commencement of every run the die is heated to a cherry red, the initial severance being solely due to the presence of air in the die, and the subsequent reunion of the metal, to its absence.

The die plate is mounted in a holder, in which it is easily fixed, or from which it is readily removed, as different sections are required to be pressed. As it is necessary to heat the die and its holder previously to each pressing operation, as already mentioned, the die is fitted into a shouldered recess in the holder, which is coned to seat into a hollow metal block. This block is firmly held in position during the operation of pressing by a pair of gripping jaws actuated by hydraulic power. The die holder and the gripping jaws ...

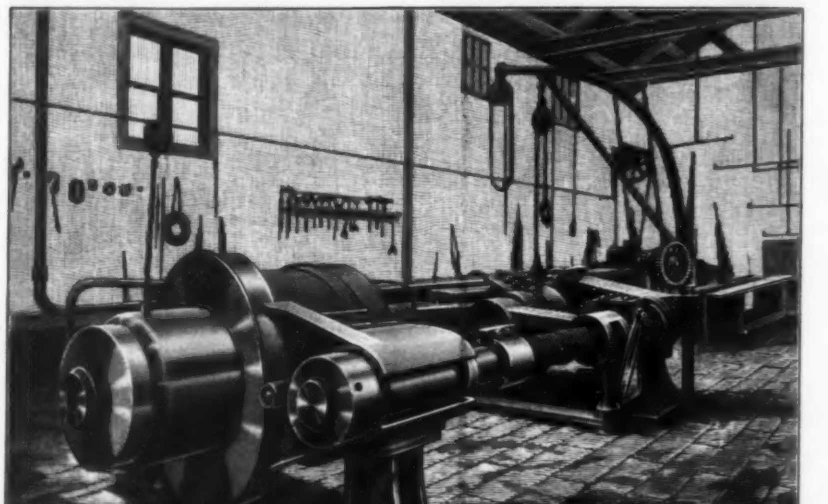


FIG. 1.

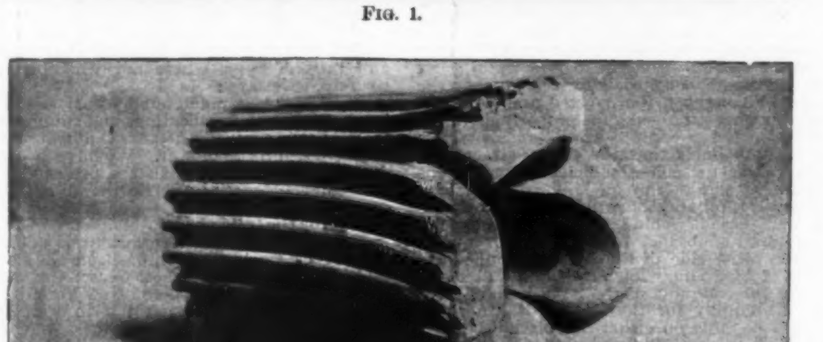


FIG. 4.

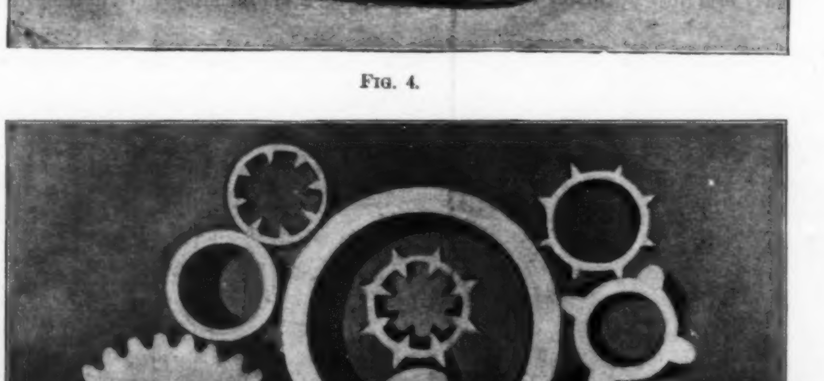


FIG. 5.

THE PRODUCTION OF TUBES BY EXTRUSION.

ried in a strong crosshead. The metal is forced out of the container and through the die by a hydraulic ram 20 inches in diameter, and working under a pressure of 2 tons per square inch. The ram has a prolongation or extension of reduced diameter, which forms the plunger of the container, entering it at the opposite end to that at which the die is situated. A different plunger is used with each container, the diameter varying to suit the internal diameter of the container. On starting to work each day the container is first heated up by gas with a Bunsen burner, which quickly brings the liner to the temperature necessary to prevent the first charge of metal receiving a chill. The container does not require reheating, as the liner remains red hot after each run.

Such in general is the arrangement of this ingenious system of tube production. Its operation may be best described from our own observation during a recent visit to the Delta Metal Works, Pomeroy Street, New Cross, London. The machine was running on tubes of 2¼ inches and ¾ inch in diameter respectively. In the case of the smaller tubes, four were produced at each pressing, while in the case of the larger tubes only one was produced at each run. A charge having just been put through, the opening at the front end of the container—that next the die—was closed by a removable plate or stopper, and the container was up-ended in a vertical position with the closed end at the bottom. A billet of delta metal weighing about 1½ cwt. and heated to plasticity was then placed in the container. The diameter of the plunger, and that of a loose block which is placed between it and the charge, being less than the diameter of the steel liner, the plastic material when under pressure would be forced backward between the block and the liner were it not restrained. In order to prevent this back flow taking place, a dished steel check disk which is less plastic and more rigid than the heated metal at the working temperature, is first placed on the top of the charge, and when the pressure is brought on, the disk is expanded and completely fills the bore of the liner, thus effectually preventing the back flow of the metal.

The loose steel block just referred to was then placed upon the check disk, and having been previously heated, it prevents the cold end of the plunger chilling the charge of metal. The plunger being of smaller diameter than the liner, there is no fear of the latter becoming chilled by the former. To preclude all chance of such an occurrence, however, the back of the loose block is recessed and receives a corresponding projection on the front end of the plunger, which is thus maintained in a central position and is prevented from coming into contact with the liner. The block having been inserted, the container was brought into a horizontal position, the front stop plate removed, and the container run up to the die block, which, with the die, had been previously heated. The hydraulic pumps were then started, and in four minutes the charge was expelled and had become connected into lengths of tubes of the diameters stated. The gripping jaws were then released and the ram continued its forward travel, pushing out the remainder of the metal or stump, together with the die and its holder as well as the check disk and the loose block, leaving the container perfectly clear for the next charge. The tubes were then cut off from the stump or fag end of the charge; the die and holder replaced by others; the stopper of the container fixed in place, and the container up-ended for another charge, a similar cycle of operations to those just described being then carried out.

We thus have an ingenious application of the principle of extrusion to an important industrial purpose. That the system possesses great possibilities is evident from the variety of tube sections that are produced by it in delta metal—which itself embodies several important physical characteristics. The wide range of tube sections produced will be seen on reference to Fig. 5, which illustration is prepared from a photograph of some of the sections ordinarily being made. The process, moreover, improves the quality of the metal, owing to the great pressure put upon it, in the same way that Whitworth steel is improved by compression. Some tests made at Woolwich Arsenal with delta metal bars produced by extrusion show a tensile strength of 48 tons per square inch, with 32·5 per cent. elongation on 2 inches, against 38 tons per square inch tensile strength and 20 per cent. elongation of rolled bars of the metal. Compared with ordinary yellow metal the increase in tensile strength is 24 per cent., with a proportionate increase in elongation. In some tests made in France with rolled yellow metal bars, the tensile strength was 50·5 kilogrammes per square millimeter, with 18 per cent. elongation on 10 centimeters; while extruded bars of the same metal gave 54·6 kilogrammes per square millimeter, with 25 per cent. elongation on 10 centimeters. Rolled delta metal bars gave 73·3 kilogrammes per square millimeter, with 28·8 per cent. elongation on the same length; while extruded bars of that metal gave 76·6 kilogrammes per square millimeter (48·6 tons per square inch), with 29·8 per cent. elongation.

That the extrusion process considerably increases the strength of tubes is shown by some tests, in which the mean bursting pressure of three samples of extruded brass tubes 1.336 inches in diameter by 0·073 inch thick, was 6·570 pounds per square inch, which, by the well known formula

$$p = \frac{D^2 - d^2}{D^2 + d^2} f$$

in which

p = bursting pressure in pounds per square inch
D = outside diameter in inches
d = inside " "

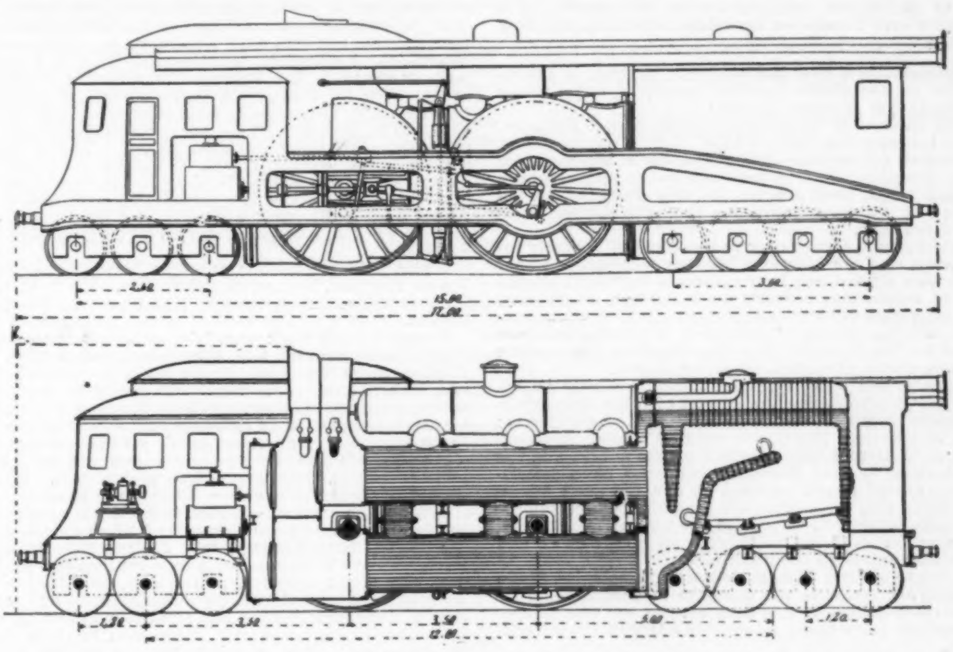
gives a value of 54,000 to f for extruded brass tubes, whereas in ordinary solid drawn brass tubes the value of the constant f is only 30,000, and even for manganese bronze tubes only reaches 44,500. With regard to tensile strength, pieces of extruded brass tubes were tested longitudinally and transversely, the mean of six tests of the former giving an ultimate strength of 31·5 tons per square inch and 29·3 per cent. elongation, the six transverse specimens giving a mean of 28·8 tons per square inch with 9·8 per cent. elongation.

The development of the extrusion system of manufacturing metallic bars and tubes is shown by the circumstance that there are no fewer than 19 presses on Mr. Dick's principle in operation in this country and on the Continent, while plant for three more is being laid down. The presses already in operation are at present turning out solid sections only, but they are all being fitted with the necessary appliances for the production of tubes by extrusion.

A NEW HIGH SPEED LOCOMOTIVE.

IN a lecture recently delivered at Alexandria before the members of the Egyptian group of engineer graduates of the Central School of Arts and Manufactures, M. Thuile, engineer of the port of that city, offered a few considerations upon the means necessary to increase the speed of express trains, and presented a somewhat original project for a locomotive capable of maintaining a continuous speed of 72 miles an hour.

We borrow from Le Génie Civil a brief description of this proposed engine, which is represented in elevation



FIGS. 1 AND 2.—ELEVATION AND LONGITUDINAL SECTION OF THUILE'S HIGH SPEED LOCOMOTIVE.

and in transverse and longitudinal sections in Figs. 1, 2, 3, and 4.

The fire box, which is of large capacity, is divided into three compartments by a water space of the Ten Brink system and a vertical refractory water screen, which thus form obstructions to the passage of the gaseous current. The grate has a superficial area of 62 square feet and will thus require the services of two firemen to coal it. This arrangement of the fire box is subject to criticism, since the structure of it is very complicated, and it presents great dangers of leakages at strong pressures. Besides, the refractory screen which masks the aperture of the ash-pan renders the access of the air necessary for the combustion very difficult. The boiler has four cylindrical bodies, the two lowermost of which are provided with tubes. The steam occupies only half of the capacity of the two upper reservoirs, the axes of which are situated in the same horizontal plane. The generator possesses a large reserve supply of liquid and, consequently, of caloric, but the volume of the steam and the horizontal surface of the plane of water offered to the disengagement thereof, seem to be inadequate. The upright boiler tubes, too, have a section that is not in keeping with the intensity of vaporization that will be required from

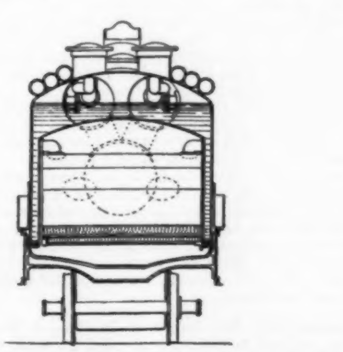


FIG. 3.—TRANSVERSE SECTION THROUGH THE FIRE BOX.

the boiler, and there will certainly be danger of priming. The tubes are smooth, and are 2¼ inches in external diameter and 16 feet in length. With such a length, unusual in the generators of locomotives, the use of tubes with wings of wide section was certainly indicated.

The smoke box is divided into two independent compartments and surmounted by two distinct smokestacks, at the base of each of which debouch the escapements of both cylinders. This ought to assure an equal distribution of the draught between the two bundles of tubes.

The driving axles are placed between the two lower cylindrical bodies of the boiler. Such an arrangement will present genuine inconveniences when it becomes a question of removing the wheels for repairs. In such a case it will be necessary to dismount the lower boiler.

The cylinders, which are two in number, are simple expansion ones. Their diameter is 24 inches and the stroke of the piston is 32.

The frame is exterior to the coupled driving wheels, which are 9·85 feet in diameter. In order that the elasticity of the engine may be increased in the passage of curves, spiral springs for the wheels are dispensed with.

The front of the engine, arranged as a wind cutter, contains the cab of the engineman, who will have within reach all of the maneuvering and indicating apparatus. Herein, too, are found the electric installations, which consist of two small compound steam engines that actuate a dynamo designed to effect the lighting of the train.

Upon the top of the locomotive there is placed a ventilator formed of six large pipes capable of being coupled with others of the same diameter fixed upon the roof of each car. Through this apparatus there is sent into each compartment, and according to the season, cold air or air heated by the steam of the boiler.

The weight of the locomotive and tender, empty, is 119 tons, and, loaded, 139 tons, only 32 of which are utilized for adhesion. In view of the power of the engine, and as compared with ordinary locomotives, such figures appear feeble.

The tender in particular, which is supported by two bogies, would certainly weigh, when empty, more than 12 tons with the accessory installations with which it is provided. It carries 5,280 gallons of water and 17,600 pounds of fuel. We estimate that M. Thuile's locomotive would, in running order, weigh, with its tender, more than 180 tons, distributed over the thirteen axles that support the two vehicles.

We learn, says Le Génie Civil, that M. Thuile found that his project was not entirely free from criticism, for he has just completely overhauled it and eliminated most of the defects that had been pointed out, and is now having constructed, by way of experiment, a powerful high speed engine established upon principles

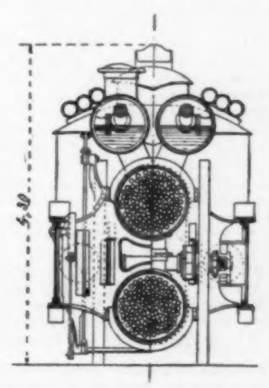


FIG. 4.—TRANSVERSE SECTION THROUGH THE CYLINDRICAL BOILER BODIES.

that are notably different from those that served as a basis for his first study.

IF a German scientist is to be believed, everything needed to make a man weigh 150 pounds can be found in the whites and yolks of 1,200 hen's eggs. "Reduced to a fluid," declares the savant, "the average man would yield ninety-eight cubic meters of illuminating gas and hydrogen—enough to fill a balloon capable of lifting 155 pounds. The normal human body has in it the iron needed to make seven large nails, the fat for fourteen pounds of candles, the carbon for sixty-five gross of crayons, and phosphorus enough for eight hundred and twenty thousand matches. Out of it can be obtained, besides twenty coffee-spoonfuls of salt, fifty lumps of sugar and forty-two liters of water."

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

American Canned Goods in Germany.—Consul Brundage, of Aix-la-Chapelle, writes as follows, on January 16, 1899, concerning the tariff assessed upon American canned goods in Germany:

I received a small consignment from the United States, for my personal use last week, viz.: Two dozen 2-pound cans of pumpkin, 2 dozen 2-pound cans of corn, 1 dozen 1-pound cans of cove oysters, 2 dozen 2-pound cans of clam chowder, and 2 dozen 2-pound cans of peaches. The total value of same, as billed in the United States, was $12.10; net weight, 228 pounds (boxing included). I paid as customs duty the sum of $14.85. I write this fact as it best answers inquiries by exporters of canned goods seeking sales in Germany. They are virtually prohibited. They are classed as "conserves," and as such are dutiable at the rate of 60 marks ($14.28) per 100 kilogrammes (220 pounds), or a fraction over 7 cents per avoirdupois pound, including packing.

Consumption of Beer in Spain.—Mr. Mertens, in charge of the United States consular agency at Grao, writes under date of January 27, 1899:

The captain of one of the German Lloyd steamers, upon bringing the "repatriados" to this port recently, expressed his surprise at the Spaniards' fondness for beer, regretting that he had not had a larger supply aboard during their journey, he, like many others, being under the false impression that the Spaniards do not drink beer.

The consumption of beer in this country is yearly increasing, and our American brewers, who can well hold their own against any beer makers of the world, should try to secure this country for a market, introducing the kind that will suit the Spanish taste. I would suggest that, for an easy introduction, a Spanish brand or label in the Spanish language, with an appropriate sign to attract attention, might be chosen.

Nothing can be said against the enterprising American way of advertising the articles of home industry in different languages and by illustrations the world over; but in countries like this it requires a more imposing means to attract the attention of the public, and the style which several European countries have successfully adopted should be tried by our American manufacturers, viz., exhibitions on a small scale of sample deposits, either in a certain important commercial place or on steamers touching from port to port and soliciting orders on their exhibits.

I beg to observe that, since losing its colonies, Spain is studying seriously the question of raising both tobacco and cotton in this country, the soil and climate in various parts being admirably adapted for the purpose.

Baling American Cotton.—This consulate, says Consul Max Bouchsein, of Barmen, has been requested to report public opinion of the new system of baling American cotton, called the "Lowry bale."

As there are no cotton mills in my consular district, I, through the good offices of the Barmen Chamber of Commerce, had the matter referred to the directors of some of the largest cotton mills in Germany, and the information so obtained may be interesting to the entire American cotton industry.

The reports criticise in general the former method of baling American cotton. It is a well-known fact that the old system is very unsatisfactory; the bales weigh from 400 to 500 pounds, are of irregular size and difficult to stow away in railroad cars and ships. As a consequence, the packing or covering suffers greatly and the cotton reaches Europe in inferior condition.

It has been recommended to pack American cotton in a style similar to the cotton received from the East Indies, which comes in bales equally long and wide, covered with thick Indian hemp and with a number of iron bands. All efforts made in the direction of introducing a system by which bales of a somewhat uniform appearance could be obtained have failed to prove successful, it being claimed that, in order to reach this end, the machinery now in use would have to be replaced by entirely new apparatus, which would incur immense cost.

A few years ago, an American company brought into the market "round bales." These bales are made by winding the cotton, as soon as it leaves the gin, under high pressure into cylinders of 36 to 40 inches in length. These bales have no iron bands, but are sewed into thick Indian hemp, which is only one per cent. of the weight of the cotton, whereas formerly the packing weighed six per cent. The bales packed according to this system reached Europe in good condition, the volume being considerably smaller, and the cotton being protected from dirt and moisture. In working up this cotton in the spinning mills, however, it has been noticed that the fiber sticks together too much, which injury seems to be due to the irregularity of pressure, the density being too great in the center of the bale. It is claimed that this trouble is thoroughly overcome by the Lowry system, and some of the leading cotton consumers look favorably upon the new method. If it proves to have the advantages claimed, they will gladly accept it in preference to the square bale.

Market for Textiles in Peru.—German textile journals are telling the cloth makers of the empire to take their wares to South America, particularly to places hitherto unvisited, says Consul J. C. Monaghan, of Chemnitz. Among these is Iquitos, capital of the province of Loveto, in Peru. Situated near the headwaters of the Amazon, South America's largest river, having relations with regions watered by its tributaries, the Ucoyali, Napo, Yavary, Rio Tigre, Jacua, etc., easily approached, inhabited by as energetic and enterprising a population as one will find in the lands south of the equator, it has all the conditions necessary to make it a great trade center. On the Pacific, a few mills make buckskins, cheviots, blankets, etc., but, because of the enormous cost for freightage over the Andes, sales are local. Mules have to carry goods over the comb of the Cordillera, and this cost cuts off all possibility of competition with countries as well equipped as are England and Germany; this, in spite of steamship freight rates, which run $30 per cubic meter (35·547 cubic feet), and import duties based on a desire to obtain revenues as well as to protect home industries.

Up to the present, the demand for German goods has been confined to manufactured articles. Among these are moleskins, in good and middle grades, in whole "cuts" or pieces of 2½ yards; woolen and cotton blankets (England competes in this line); cotton and silk laces and summer worsteds in cheap and middle grades; in the last a large business has been built up. Cotton hose, black and in colors, have sold well. Cotton prints, patterns that went ten years ago from Manchester, still find favor. Germans are unable to assign a good reason for this. My own impression is that it is due to the excellent qualities of the goods. The trade is not confined to bright colors; many of Alsace's soft, quiet patterns are in demand. England sends large quantities of nettings (mosquito), tulles, gauzes, and mulls, white cotton shirtings, napkins, towels, linen and cotton handkerchiefs, white drills, gray domestics, gray linen drills, Hessians, and sailcloths. Large quantities of colored cottons for shirts, as well as ready-made shirts, are going in. Colored pajamas and various kinds of underwear are imported from England and Germany, in about equal quantities. Switzerland sends hammocks (it is a good plan to weave in the Peruvian or Brazilian coat of arms), cords for hammocks, handkerchiefs (especially colored lines, fantastically embroidered imitations of silk handkerchiefs). These are great favorites with the natives in their national dance. The United States sends cotton goods, especially blue drills. France sends corsets, shawls, silk ribbons, cloths, caps, sunshades, etc. There is a good business in hats and ready made suits, that will wash, for any firm that goes to work in the right way to win the market of Iquitos.

White drill pantaloons are sent from the United States, England, France, and Germany. Much of the trade in this section is done by Hamburg and London houses.

If anyone will work the field, taking care to send catalogues in Spanish and Portuguese, rather than in English, there is no doubt that a fairly profitable business can be built up. Small shipments of samples, with a guaranty that goods will go in equal to or better than samples, is an excellent way to win favor in those countries. At present, goods go in every five or six weeks, via the Booth-Iquitos line, whose boats leave Liverpool, Hamburg, Havre and Lisbon. Rates should be made "free on board" at one of these ports.

It is in such markets—in fact, in the fields sought by the merchants and manufacturers of this empire—that the United States should win its greatest success. Here, we have to contend with conservatism and prejudice. In South America, in the East, in Africa, and Australia, we meet Germany's manufacturers and merchants in markets as open and favorable to our efforts and enterprise as to theirs. It is in such markets that we must seek those openings for our exports made necessary by our rapidly increasing power to produce.

Pumps in Mexico.—Consul Kindrick, of Ciudad Juarez, in answer to an inquiry of a New York firm, writes under date of January 10, 1899:

There is no article of common use so much required in the northern section of this republic as the ordinary hand pump. The soil is arid and dry and free from surface springs and small streams. There is not sufficient annual rainfall to keep cisterns filled with drinking water, and almost the only source of fresh-water supply consists of wells sunk in the earth. The water is secured by hand pumps and windmills. They are necessary at every Mexican home, at all the mining camps, and on the cattle ranges. At the camps and on the ranges windmills are used, and they are invariably of United States manufacture.

There is a growing demand for windmills and hand pumps of the latest and most approved pattern. A windmill or pump is as essential to a home in northern Mexico as a cooking stove. In consideration of the fact that pumps are such an important factor in the economy of domestic establishments, the Mexican government admits them free of duty.

For the fiscal year ended June 30, 1898, there was imported at the custom house in this city $57,200 worth of pumps. Of course, they were not all used in this immediate vicinity, but were distributed through the country by the railroads which touch the border between the United States and Mexico at this place. It is safe to assert, however, that most of the pumps imported were used in the northern section of the republic, because they are more necessary in this locality.

The Mexican Central Railroad and the Rio Grande, Sierra Madre and Pacific Railroad are the distributing agents from this point.

The best way to introduce an article of manufacture in Mexico is to dispatch a capable and qualified commercial traveler who understands the language of his customer and the methods of the country. But whether or not it would pay to do this in the matter of enlarging the demand for pumps, I am not prepared to state.

Messrs. Ketelsen and Degetau, of this city, are general merchants who handle a great deal of American machinery and distribute it throughout the republic. They are the principal agents through whom various articles of United States manufacture find a market in this part of Mexico.

Demand for Hardware at Malta.—A few years ago some Maltese capitalists erected at Valletta an apartment house, which was an entirely novel idea for the island of Malta. The experiment was so successful that every one of the thirty flats has been constantly occupied. The owners are now going to construct more buildings of the same class and the latest improvements in hardware, elevators, plumbing, etc., will be adopted. American goods are well thought of in Malta, but their representation is somewhat limited, due to a lack of direct communication with the United States. Mr. J. H. Grout, Jr., our consul at Malta, has succeeded in interesting the parties who were to build these flats, and has explained how our flat buildings are constructed and finished, and the fittings used. They have requested him to procure for them illustrated catalogues and price lists of goods pertaining to the fitting up of buildings, etc. It is thought that this will be the means of establishing trade with Malta.

Fertilizers in Japan.—As constant cultivation of the soil is necessary in Japan to raise crops sufficient to sustain its population, fertilizers must be used to an enormous extent; and I believe, says Consul Harris, of Nagasaki, that there is a possibility of American manufacturers of commercial fertilizers finding a market for considerable quantities of their product.

In the year 1897 there were imported into this consular district the following commercial fertilizers:

Articles.	Quantity.	Value.
	Long Tons.	
Oil cake (known also as "bean cake")	101,457	$1,651,163
Beans, pease, and pulse (known also as "seed cake," and including cottonseed cake)	139,844	2,933,029
Dried sardines	7,473	143,755
Bones	750	30,582
Total	249,524	$4,758,529

Besides these large importations, which appear in the Japanese customs returns and are therefore readily accessible, there was probably almost as much more, at least of the sardines and other fish, brought into this district from other parts of Japan, particularly the Hokkaido, and it would not be unreasonable to assert that the value of this industry amounts to something like $7,000,000.

The imported materials are broken up into small pieces and thrown into vats, where they are mixed with night soil, animal and vegetable refuse (all of which is carefully preserved for the purpose), and with water. When the fields are prepared for planting, the mixture is poured into the rows or scattered over the surface and thoroughly mixed with the soil in preparing rice fields. Afterward it is applied direct to the growing plants from small hand dippers.

A somewhat different method would have to be followed if the Japanese are to be induced to try American commercial fertilizers, but it is believed that the farmers can be taught to use them properly.

The following firms may be communicated with, if further information as to the details of the business be desired: China and Japan Trading Company, Limited; American Trading Company; Holme, Ringer & Company, and Browne & Company.

Imports into Honduras.—In his annual report (which was published in Commercial Relations, 1897–98) Consul Johnston, of Utilla, says that the United States has the majority of the imports into Honduras. In some lines, however—for instance, thread, lace insertion, etc.—the English have all the trade. In cotton goods, some English products are sold, but they are mostly from the United States, especially in the finer grades. The heavier qualities are not sold in shirtings, but the cottons used for sails and ticking are all American. The market will use twice as much of a first-class article as of an inferior. On the island of Utilla, where the English and not the Spanish language is used, school books from the United States are in demand, and if introduced, says Mr. Johnston, would be exclusively used. In woolen goods the English have the lead. The demand is for fine, light-weight goods, to be used for trouserings, etc. Cottons of heavy weight take the place of the thicker woolens. The finish and style of all United States products are first class. American whisky is always commended, and our beer is sold, so far as Mr. Johnston has seen, to the exclusion of all other. The consul gives the following advice as to packing, etc.: Pickles should be put in bottles attractively labeled. Those sold here are put up in England. Cornstarch should be put in two-ounce packages and five or ten pounds in a box. The English product, labeled "cornflour," is chiefly sold. Oatmeal, cornmeal, etc., should be in airtight packages, as in the climate of Honduras they soon spoil and are a loss to the merchant. No candles are imported from the United States, for the reason that they melt, while those from England are put up in tin cans and keep well. There is a good trade in this line. The great drawback to imports is the duties. The published rates are so much a pound; but there are additional charges which make the tariff about double. For instance, a party bought two and one-half kegs of nails in the United States; when the duty was paid, they cost $11.20 gold. Another party bought $78 worth of furniture, the duties per published rates being 26.32 pesos (the peso being worth about 43 cents); 5.04 pesos were charged for weight, plus 30 per cent., plus 20 per cent., plus $10.50 for paper at custom house, making the total 59.42 pesos, or $23.76 gold.

Electric Lamps in Brussels.—In his annual report (which will be published in Commercial Relations, 1897–1898) Consul Roosevelt of Brussels, says:

The employment of electricity for illuminating purposes is rapidly extending to this city. The lamps, as well as nearly all other electrical supplies here, are of German origin; Holland supplies a few and England a fair percentage of the electrical wires employed. American lamps and other electrical goods are exposed for sale on this market, and are conceded to be superior to those imported from Germany, France, and England, and with proper effort the trade in this line could be greatly increased. Especially in copper wire, insulated wire, large cables, and arc lamps is there an excellent opening.

American vs. Foreign Commercial Travelers.—Consul-General Stowe, in a communication dated Cape Town, September 24, 1898, says that English writers complain that the commercial agents sent abroad to represent firms in their country are generally young men who have worked in the office until they are run down in health, and who go abroad for a change, with no knowledge of the business except that gained behind a desk. A French consul writes in the same line that French merchants are willing to accept as representatives abroad men who have failed in their own country. The English writer, who is himself a commercial traveler, adds:

"United States merchants and manufacturers send out a high class of representatives, astute men, who have large and varied experience in their respective lines; men educated in the details of the business they represent; men of the age that brings wisdom and accuracy; men that earn and command the largest salaries; and men of push, energy, and vigor."

ELECTRICAL NOTES.

It has been decided to light the interior of St. Paul's Cathedral, London, electrically. The necessary sum, which will not amount to less than $35,000, has already been raised.

It is proposed to use electromagnets for recovering a large load of steel rails which was sunk in the Ohio River, says The Electrical World. A crane boat will be equipped with waterproof magnets capable of lifting 4,000 pounds each. The work will be done by the Langton Electric Company, Pittsburg, Pa.

Preparations are being made by the United States Navy Department for the establishment of a school of electricity for enlisted men at the Brooklyn navy yard. It is proposed to train the former apprentices or men acquainted with a machine trade, so that a capable corps of qualified electricians can be organized.

A recent catalogue of electric heating apparatus gives the following data of energy required for the cooking utensils named: Chafing dish, 440 watts; broiler, 1,500 watts; griddle (large), 1,500 watts; farina boiler, 440 watts; stew pan, 200 watts; coffee heater, 400 watts. The current is found by dividing the watts by the voltage.

That electric power generated in central stations is gradually replacing steam power is shown very well in the annual report of the chief of the Bureau of Engines and Boilers in the city of Philadelphia. Out of a total of 3,579 boilers under the supervision of that bureau, there are 625 which are temporarily out of use, the chief reason being that electric power is gradually being substituted for steam power.

The Western Union Telegraph Company announces a reduction in the rates to Cuba and Porto Rico as follows, which took effect February 15: From all points in the United States east of the Mississippi River, including also St. Louis, to Havana, 25 cents per word in place of the present rate of 40 cents. From all points in the United States west of the Mississippi River, excepting St. Louis, to Havana, 35 cents per word, in place of the present rate of 50 cents. To Cienfuegos, Casilda and Tunas, 20 cents more than to Havana; and Jucaro, Santa Cruz, Manzanillo and Santiago, 25 cents per word more than to Havana. To Porto Rico from all points in the United States east of the Mississippi River, including St. Louis, Mo., 75 cents per word, in place of the present rate of $1.17. From all points in the United States west of the Mississippi River, excepting St. Louis, 85 cents per word, in place of the present rate of $1.27.—Electrical Review.

United States Consul Smith, of Moscow, Russia, on January 21, 1899, writes: "The city council of Moscow has made known that it will publish in Russian and foreign newspapers a statement on February 12, advising all contractors who are desirous of bidding for the construction of electric railroads in the city to make applications to the city council not later than April 12. The sum of 750 rubles ($375) must accompany each application. The council will give all parties presenting applications the terms and conditions of the concessions, with all necessary drawings and statistics as to the working of the tramways in Moscow for the past five years, profits of the different localities, list of lines existing, and approximate prices for making out the estimates. For foreign bidders there will be issued copies of the contracts printed in foreign languages, which will be sent on demand to all electrical companies. Copies will be sold to all applicants desiring paticulars of the contract to be issued. The date of presenting the final tenders will be October 1, 1899."

The United States ocean-going tug "Assistance," whose hull was electroplated and launched in February, 1895, was recently docked at Norfolk and subjected to a critical examination. The report of the naval construction department states that the vessel's bottom was found to be absolutely free from barnacles or marine growth of any kind, and it is recommended that the process be applied to the war ships of the navy. It is suggested that not less than $\frac{1}{16}$ inch of copper plating should be placed on the bottom of the vessel, and it is believed that no corrosive effect due to electrolysis will result from such electroplating. Briefly stated, the method of electroplating the hulls of vessels is about as follows: A shallow, flexible box-shaped plating bath is supported against the side of the vessel and filled with the plating solution. The vessel is made the negative pole of the circuit, by connection with an electric generator, and a copper electrode in the plating solution furnishes the positive pole. A current of 7½ amperes to the square foot, at a difference of potential of 1½ volts, is employed, and about three days are required to deposit a plating of suitable thickness in one place. The electroplating progresses by patches, small portions of the hull being cleaned in advance of the removal of the plating bath from point to point about the hull.

K. Elbs and A. Hertz give particulars (Zeit. f. Electro-Chemie) of an electrolytic method of preparing iodoform. This substance is produced when the alkaline or alkaline-earthy iodides are subjected to electrolysis in presence of alcohol, aldehyde, or acetone. By the former method the electrolyte should be traversed by a stream of carbon dioxide gas during the operation to saturate the alkali set free by the electrolysis of the iodide. The authors show that the current of carbon dioxide is advantageously replaced by the simple addition of an alkaline carbonate to the electrolyte. The following solution answers best:

Potassium carbonate	5 grammes.
Potassium iodide	10 "
Alcohol	20 c. c.
Water	100 "

Every hour the iodoform is removed and the strength of the solution in the several ingredients made up to the standard. From many experiments they conclude (1) that the proportion of hydriodic acid formed increases as the temperature rises above 60° to 70° C.; (2) that the yield of iodoform diminishes if the density of the current exceeds 1 ampere per square decimeter; (3) that increase of carbonate in the electrolyte slightly diminishes the yield of iodoform and largely increases the proportion of hydriodic acid; (4) that replacement of alcohol by acetone gives far less satisfactory results.

MISCELLANEOUS NOTES.

A remarkable proof of the expansion of German trade is furnished by the traffic returns of the Suez Canal. Twenty years ago the German share of the canal traffic was 1 per cent. of the total tonnage. It is now 11 per cent., a large proportion of the trade being with British possessions.

United States Consul Mayer, of Buenos Ayres, writes on December 27, 1898: "It affords me great pleasure to report that for the first time American coal has arrived here in sailing vessels. The American schooners Mary E. Palmer and William B. Palmer, Capts. W. H. Haskell and L. McDonald, arrived here from Norfolk, Va., with 4,851 tons of Pocahontas coal. They made the trip in forty-nine days. Both left Norfolk on the same day and both arrived at this port on the same day. This is a new era for American shipping, and it will not be long until Argentina will receive her entire coal supply from the United States."

It is a fact that English and colonial printers prefer American machinery when obtainable, even passing by the product of English factories to purchase our machinery. The reason is that American presses are so well and accurately made. A prominent London publisher, Sir Joseph Causton, admitted, when he was here last year, that the English machinists did not have suitable tools for making presses, and further, if they had the tools, the men would not know how to handle them advantageously. He said, too, that if English press builders sent men over here to learn how to use American tools, they never returned, the opportunity for skilled press builders being so much better here than in England.

The history of a city directory is always an interesting topic, and in London and New York the bulk of such publications increases with leaps and bounds. In The Academy the origin of The London Post Office Directory is described, or, as it is best known in the great metropolis of the world, as "Kelly's." Originally it was a kind of perquisite of the Inspector-General of Letter Carriers, and the letter carriers who canvassed for the directory earned their commissions. Later the father of the present publisher took the directory on his own account when it was deemed valueless. Under his excellent management its success was assured. The oldest London directory is dated 1736. The Academy has put the last edition of Kelly's in the office scale, and it weighs "eleven pounds one ounce."

The compilation of passengers landed at New York from Europe during 1898 shows an aggregate of 80,586 cabin and 219,657 steerage in 812 trips of transatlantic steamers. This compares with 90,932 cabin and 192,004 steerage in 901 trips during 1897, which was the smallest number of passengers arrived here in a number of years. The Cunard line continued last year to hold their supremacy in cabin passenger trade from England, bringing 16,692, as compared with 15,197 in 1897. They also brought last year 20,463 steerage—an increase of 3,160 over the previous year. The American line traffic, owing to the war, which necessitated the withdrawal of the express steamers, dropped from 14,443 cabin in 1897 to 5,037 last year, with 5,890 steerage passengers, against 11,322 in 1897.

In a recent issue of The Engineering and Mining Journal an interesting account of a new safety-match, which is already long past the experimental stage, is given. The match is the outcome of a reward offered some time back by the Belgian government for a substitute for white phosphorus in making matches. The active agent in the new matches is the sesquisulphide of phosphorus in admixture with chlorate of potash, and their invention is due to MM. Sevene and Cohen. The sesquisulphide of phosphorus is a very stable body, which can be kept for an indefinite time without undergoing change. It is prepared by heating the non-poisonous form of phosphorus with sulphur, when it forms as a gray-yellowish substance, which ignites at 203° F., and can therefore be ignited by rubbing in the same way as ordinary phosphorus. We are told that the new matches have become popular during the few months they have been obtainable, the public having hardly noticed any change, as the new matches much resemble the old in appearance. They have a very slight sulphury smell, but too slight to be unpleasant. Of course, like all phosphorus matches, they are to some extent poisonous; but as they are prepared from the amorphous form of phosphorus, the great evils at present so much dreaded by those engaged in the manufacture of phosphorus matches need not be feared.

The postal authorities are endeavoring to reduce the time of transcontinental mails from New York to San Francisco to 95 hours—a reduction of 13 hours from the present schedule. The first train to try the experiment left New York January 1 at 9:15 P. M. and arrived in Chicago at 8:28 P. M. the next day, 2 minutes ahead of the scheduled time. From Chicago to Omaha the mail was carried by two trains, one over the Chicago, Burlington & Quincy road, and the other over the Chicago & Northwestern. The train on the former road reached Omaha 8 minutes ahead of time, although no attempt to beat the schedule was made till the last division was reached, while the Northwestern train, in pursuing the same plan, reached Omaha 18 minutes ahead. The distances covered were 502 miles in 10 hours and 23 minutes by the Burlington train and 492 miles in 7 hours and 58 minutes by the Northwestern. The run of the latter train was made inclusive of eighteen stops and one stop of 2 minutes because of a hot box. The fastest speed reached by it was a mile in 37 seconds, which was maintained for a distance of 5 miles. Even better time was made on January 3 by an east-bound mail train which left Omaha an hour and 2 minutes late and reached Chicago on time. This train ran over the Burlington road and covered the 502 miles, including all stops and delays, in 9 hours and 23 minutes—an average rate of a mile in 1·12 minutes. From Burlington to Chicago, a distance of 206 miles, the actual running time was 200 minutes. The notable feature of these runs is the high rate of speed which was maintained with ease for such long distances. It would seem that, given favorable conditions, the present time of transportation of the New York-San Francisco mail ought to be considerably reduced.

SELECTED FORMULÆ.

Shoe Dressings.—Dressings for ladies' shoes must be somewhat varnish-like, so as not to rub off when the leather becomes damp. They of course tend to harden the leather.

Anilin black	5 parts.
Camphor	10 "
Shellac	120 "
Wood alcohol	365 "

The wood alcohol is used only because it is cheaper than grain alcohol; the latter may be employed if desired.

Shellac, which is the ingredient giving luster to the dressing, may also be dissolved in an aqueous alkaline solution, according to the appended recipe:

Shellac	2 ounces.
Ammonia water	1 "
Water	6 "
Anilin black, sufficient to color.	

Boil all the ingredients together, except the anilin, until the shellac is dissolved; then add the anilin and sufficient water to make the liquid up to the measure of 16 ounces.

Hager gives the following formula for producing a similar result in a different way:

Gallic acid	5 grammes.
Borax	5 "
Logwood extract	2·5 "
Anilin black	10 "
Ammonia water	10 "
Hot water	50 "
Aqueous shellac varnish (as below)	2,000 "

The aqueous shellac varnish is prepared as follows:

Borax	100 grammes.
Water	2,250 "
Powdered shellac	300 "

Heat the water to the boiling point, dissolve in it the borax, and then add the shellac in small portions, stirring the liquid constantly until solution is effected. When cool, strain.

Polish for Gentlemen's Shoes.

I.

Bone black	2 pounds.
Molasses	1½ "
Lard oil	¼ pint.
Vinegar, enough to make a paste.	

II.

Tragacanth	1 ounce.
Water	4 "
Dissolve and add—	
Neat's foot oil	2 "
Bone black	4 "
Prussian blue	1 "
Sugar	4 "

Glycerin is sometimes used in making such pastes and, we are told, answers a good purpose.

The dressings used on russet leather consist of mixtures of wax with oil and other vehicles which give a mixture of proper working quality.

A simple formula is:

Yellow wax	9 parts.
Oil of turpentine	20 "
Soap	1 "
Boiling water	20 "

Dissolve the wax in the turpentine on a water-bath and the soap in the water, and stir the two liquids together until the mixture becomes cold enough to remain homogeneous.

Another formula in which stearin is used is appended:

Wax	1 part.
Stearin	2 "
Linseed oil	1 "
Oil of turpentine	6 "
Soap	1 "
Water	10 "
Proceed as above.	

We have recently been informed that carnauba wax is used by manufacturers of such dressings instead of beeswax, as it is harder and takes a higher polish. We advise experiment with it.

These dressings are sometimes colored with finely ground yellow ocher or burnt umber. If the leather be badly worn, however, it is best to apply a stain first, and afterward the waxy dressing.

Suitable stains are made by boiling safflower in water, and annatto is also used in the same way; the two being sometimes mixed together. Oxalic acid darkens the color of the safflower. Anilin colors would also doubtless yield good results with less trouble and expense.

By adding finely ground lampblack to the waxy mixture instead of ocher, it would presumably answer as a dressing for black leather.

The combination liquid dressing and "cleaner" seems to be an emulsion of wax. Such an emulsion may be formed, it is said, by melting the wax, incorporating with it while hot about two and a half times its weight of mucilage or gum arabic, and then twice as much water as mucilage.—Druggists' Circular.

Blackhead Lotion.—

Ether	1 ounce.
Ammonium carbonate	1 drachm.
Boracic acid	20 grs.
Water, sufficient to make	2 ounces.

Mix and apply twice a day. This acts both as a solvent and an antiseptic.—Druggist's Circular.

Laundry Bluing.—

Superfine ultramarine	4 ounces.
Ordinary ultramarine	2 "
Sodium carbonate	4 "
Glucose	9 drachms.

Mix and make into a stiff paste by the aid of water, roll out into a thick sheet, and cut into cubes, which dry at a gentle heat.

The English source from which we take the foregoing formula (Pharmaceutical Formulas) remarks of ultramarine that it is the fastest of the blues used for laundry purposes, because it is not affected by the hot iron. Indigo carmine gives equally satisfactory results, and may also be used in solution.—Am. Druggist.

THE NEW KAISERJUBILÄUMS-STADT-THEATER OF VIENNA.

In the lobby of the new Kaiserjubiläums-Stadttheater of Vienna a tablet may be seen upon which is inscribed: "In lasting memory of the jubilee of the reign of His Majesty Emperor Joseph I., two thousand Viennese families, in conjunction with the municipality of Vienna, have erected this theater with the object of fostering German art." The artistic purposes proclaimed by these words, says Illustrirte Zeitung, are also expressed by the architecture of this magnificent theater; for the structure is built in the imposing and massive style of the German Renaissance. As the illustration which we present herewith describes the exterior of the theater better than words, we shall content ourselves merely with a glance at the interior.

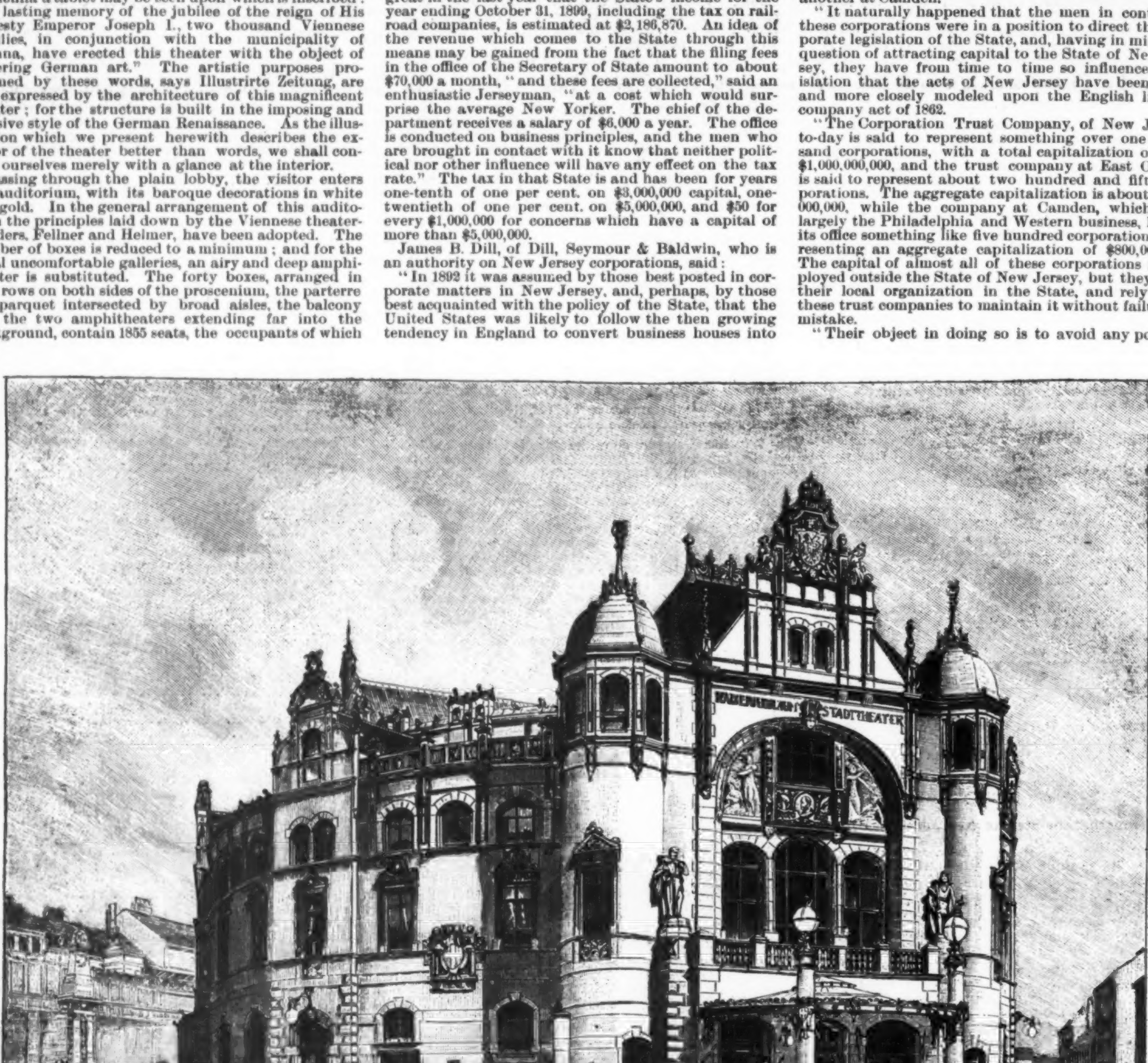
Passing through the plain lobby, the visitor enters the auditorium, with its baroque decorations in white and gold. In the general arrangement of this auditorium the principles laid down by the Viennese theater-builders, Fellner and Helmer, have been adopted. The number of boxes is reduced to a minimum; and for the usual uncomfortable galleries, an airy and deep amphitheater is substituted. The forty boxes, arranged in four rows on both sides of the proscenium, the parterre and parquet intersected by broad aisles, the balcony and the two amphitheaters extending far into the background, contain 1855 seats, the occupants of which have a clear view of the stage, as the ceiling arches the auditorium without the support of any intermediate pillars. To the left of the stage the royal box is situated, and to the right, the municipal box.

The ground upon which the theater stands was provided by the city. Toward the building expenses, the citizens of Vienna contributed one million marks in stocks, the holders of which, in addition to the interest accruing on their shares, enjoy certain privileges. The management of the theater is assumed by the city. The price of seats is lower than in other Viennese theaters, the cheapest seat costing only fifteen cents.

The Jubilee Theater is intended to be a theater for the people; and such it will become if it can attract the theater-going public by the artistic character of its plays. The management have promised to do all in their power to foster the classic German drama, to give a place to the serious and humorous German-Austrian play, to produce the works of undeservedly forgotten, as well as of rising poets. Although the theater is largely devoted to plays national in character, the works of foreign dramatists will not be neglected. The Viennese public will, therefore, have an opportunity of seeing the plays of Shakespeare, Calderon, Molière, and of the northern poets.

The management of the theater has been intrusted to the well-known author Adam Müller-Guttenbrunn, the former director of the Raimund-Theater.

The theater was opened on December 14, 1898, with a play by F. Wolf and with Kleist's "Herrmannsschlacht."



THE NEW JUBILEE THEATER OF VIENNA.

NEW JERSEY CORPORATIONS.

THE STATE'S GREAT INCOME.

The increase in "Jersey corporations" has been so great in the last year that the State's income for the year ending October 31, 1899, including the tax on railroad companies, is estimated at $2,186,870. An idea of the revenue which comes to the State through this means may be gained from the fact that the filing fees in the office of the Secretary of State amount to about $70,000 a month, "and these fees are collected," said an enthusiastic Jerseyman, "at a cost which would surprise the average New Yorker. The chief of the department receives a salary of $6,000 a year. The office is conducted on business principles, and the men who are brought in contact with it know that neither political nor other influence will have any effect on the tax rate." The tax in that State is and has been for years one-tenth of one per cent. on $3,000,000 capital, one-twentieth of one per cent. on $5,000,000, and $50 for every $1,000,000 for concerns which have a capital of more than $5,000,000.

James B. Dill, of Dill, Seymour & Baldwin, who is an authority on New Jersey corporations, said:

"In 1892 it was assumed by those best posted in corporate matters in New Jersey, and, perhaps, by those best acquainted with the policy of the State, that the United States was likely to follow the then growing tendency in England to convert business houses into private companies, and that the question would arise shortly as to the advantages offered by the respective States for charters, or, as Mr. Cook had put it in one of his late works on corporations, the question as to the advantage of the respective States as grantors of charters would be a prominent one in the minds of the American public.

"With this in view, a few prominent men conceived the idea of facilitating the organization of corporations by having a trust company in New Jersey which should devote itself wholly to corporate matters and affairs, providing a registered office, as required by law, and a trained body of clerks, who should act in connection with lawyers desiring to incorporate in New Jersey, and in all respects affording facilities to those members of the bar who desired to have a corporate home for their organizations.

A TRUST COMPANY FOR CORPORATIONS.

"A trust company charter was obtained with special powers looking to the transaction of corporate business and of acting as transfer agent and as register of stocks and bonds. The new company soon became the headquarters of incorporations in the State, and at the close of 1892 about one hundred and fifty corporations had located with it, having their principal offices in the State there, keeping there their stock books, transfer books, and minute books, each having a separate steel compartment in a safe deposit room; each, on the day of their annual meeting, being assigned to a particular room for the transaction of their business, and having a secretary who was there in the performance of his duties, and who was able to transact the necessary corporate business expeditiously and accurately. A branch of the company was established in East Orange and another at Camden.

"It naturally happened that the men in control of these corporations were in a position to direct the corporate legislation of the State, and, having in mind the question of attracting capital to the State of New Jersey, they have from time to time so influenced legislation that the acts of New Jersey have been more and more closely modeled upon the English limited company act of 1862.

"The Corporation Trust Company, of New Jersey, to-day is said to represent something over one thousand corporations, with a total capitalization of over $1,000,000,000, and the trust company at East Orange is said to represent about two hundred and fifty corporations. The aggregate capitalization is about $600,000,000, while the company at Camden, which does largely the Philadelphia and Western business, has in its office something like five hundred corporations, representing an aggregate capitalization of $800,000,000. The capital of almost all of these corporations is employed outside the State of New Jersey, but they take their local organization in the State, and rely upon these trust companies to maintain it without failure or mistake.

"Their object in doing so is to avoid any possible legal liability, or to be placed in the same position as was the Grant Coffee Process Company, which not long ago were held in this State to be copartners, because they were organized under the laws of West Virginia, but had no principal office maintained in the State.

"For this reason the companies thus chartered to do business outside of the State of New Jersey have located themselves with these three trust companies, knowing full well that the companies were officered and controlled by men of influence and standing in the State, by men thoroughly posted as to corporated matters, who could not, for their own reputations' sake, afford to make a mistake.

"In former times it was true that the larger part of these companies had simply a technical existence in New Jersey. They were not obliged by law to name a principal office or designate an agent therein, but were simply obliged to have a technical office, and hundreds of corporations had no other New Jersey existence than a meeting once a year at Taylor's Hotel in Jersey City, whence they departed at the close of a short session, carrying with them their whole corporate existence. This process of what is known as 'tramp corporations' came to a sudden end with the decision of Justice McAdam in the Grant coffee process case, and following this, immediately after, the State of New Jersey, in 1896, revised its corporation laws, compelling corporations to have and maintain a principal office within the State of New Jersey, in which there should be kept at all times their stock and transfer books, and

in charge of which there should be at all times a resident of the State of New Jersey of full age or a corporation authorized by its charter so to act.

"Later, in 1897, and finally in 1898, the Legislature of New Jersey passed an additional law requiring every corporation organized under the laws of New Jersey twice a year to file a statement in the office of the Secretary of the State of New Jersey, naming under oath the agent of the company in the State of New Jersey, naming its principal office by street and number, and providing that in case of failure so to do the individual stockholders should be liable as copartners, and further providing that in case of a false statement the officers should be liable for perjury and punishable by not less than ten years at hard labor. This act resulted in the exclusion of the 'tramp' and the 'bubble' corporations, which forthwith took their flight to such States as West Virginia, where nothing is required but a paper charter, and no further proceedings are necessary to validate the organization.

"The reason for this position taken by the State was that many corporations were evading their taxes; there was no place where they could be found, and the courts found themselves in a dilemma, because, while the laws provided that a corporation should do certain things, there was no person within the State upon whom process of the court could be served, so that, while the Court of Chancery might issue injunction after injunction against a particular corporation, there being no one upon whom to serve these injunctions, they amounted to waste paper, and nothing more.

"All this was changed in 1896, and from year to year since that time laws have been passed more and more closely compelling the corporations to come within the decision of the United States Supreme Court in the Oregon case, by having an actual bona-fide office in the State of New Jersey."

CAPITAL FROM EVERYWHERE ATTRACTED.

The New Jersey corporation laws as amended were industriously circulated, and the result of this has been that corporations have been organized from all over the United States. From the State of Illinois the notable example was that of the American Steel and Wire Company, which voluntarily gave up its charter in Illinois and accepted a New Jersey charter, with a capital of some $60,000,000, paying to the State of New Jersey $12,000 for the privilege of filing its charter and paying to the State of New Jersey an annual tax of several thousand dollars for the mere privilege of existing. It is true that there is organized under the laws of New Jersey to-day over $1,000,000,000 of New York capital, all of which is listed on the Stock Exchange in New York city.

The industrial combinations have now come into the market, so that to-day there is in the neighborhood of $2,000,000,000 of industrial combinations, the stocks of which are all on the market and the majority of which are on the Stock Exchange. These have all, with a single exception, been organized under the laws of the State of New Jersey, and from these corporations alone the State of New Jersey derives an income of nearly $1,000,000 a year.

Considering that the State of New Jersey has drawn to itself by far the major part of all of the capitalization from San Francisco to the extreme East, it was not surprising that the various States—New York, Pennsylvania, Ohio, and Illinois—should rave and carp about the liberality of the New Jersey laws; but toward the end of last year the pressure was too great upon these States, when they saw their business and their finances departing from their borders and going to New Jersey because of this policy.

HUNDREDS OF MILLIONS OF CAPITAL.

Soon after the recording of the charter of the Federal Steel Company followed the charter of the National Steel Company, and the list of New Jersey corporations now includes these:

American Tin Plate Company	$50,000,000
National Tinware and Stamped Ware Company	20,000,000
C. Rogers & Brothers, of Meriden, Conn.	1,000,000
Mexican Copper Company	1,000,000
National Steel Company	59,000,000
Minneapolis General Electric Company	2,100,000
Federal Steel Company	200,000,000
American Fisheries Company	10,000,000
Atlantic Snuff Company	10,000,000
Anderson Safe Float Company	15,000,000
Standard Distilling and Distributing Company	24,000,000
American Thread Company	12,000,000
American Indies Company	18,000,000
American Linseed Company	33,500,000
American Potteries Company	27,000,000
Continental Tobacco Company	75,000,000
International Silver Company	20,000,000
National Biscuit Company	55,000,000
Otis Elevator Company	11,000,000
United Breweries Company	5,000,000
Rubber Goods Manufacturing Company	50,000,000
American Cotton Oil Company	40,000,000
American Book Company	5,000,000
American Malting Company	26,000,000
American Tobacco Company	29,845,000
Glucose Sugar Refining Company	40,000,000
National Lead Company	40,000,000
Standard Rope and Twine Company	12,000,000
United States Leather Company	125,051,000
United Typewriter Company	18,015,000
American Steel and Wire Company	90,000,000
Pressed Steel Car Company	25,000,000
Electric Company of America	25,000,000
United Heating and Lighting Company	12,000,000
American Sugar Refining Company	75,506,000
United States Rubber Company	39,338,500
New Jersey Standard Oil Company	10,000,000
American Radiator Company	10,000,000
United Shoe Machinery Company	25,000,000
American Cereal Company	33,000,000
American Car Company	60,000,000
American Ice Company	60,000,000
New York Electrical Vehicle Transportation Company	25,000,000
Florence Mining Company	3,000,000
Union Bag and Paper Company	27,000,000
New York Auto Truck Company	10,000,000
International Air Power Company	7,000,000
Columbian Electric Car Lighting and Brake Company	10,000,000
Royal Baking Powder Company	20,000,000
Kentucky Distilleries and Warehouse Company	32,000,000
American Felt Company	5,000,000
Electric Boat Company	10,000,000
Lanyon Zinc Company	3,000,000
Continental Cement Company	10,000,000
Essex County Gas Company	50,000,000
American Shipbuilding Company	30,000,000
United States Dye Wood and Extract Company	10,000,000
Havana Commercial Company	20,000,000
Helvetia Copper Company	5,000,000

Half the ships in the world are British. The best of them can be converted into ships of war in forty-eight hours.

THE VOLCANO OF THE EXPOSITION OF 1900.

WE present herewith, from La Science pour Tous, a plan and elevation of an artificial volcano which has been projected by M. A. Jodice and will form one of the novelties of the Exposition of 1900. It will be constructed at Grenelle, on one of the banks of the Seine, upon the site of the old Cail establishments. It is to be no less than 328 feet in height by 485 in diameter, representing a circumference of about 1,460 feet and an area of about 160,000 square feet. It is, therefore, not a question of a miniature volcano, but rather of a mountain, which visitors may have an opportunity of climbing.

The sides of this volcanic mountain in full activity will be provided with attractive stations around which will be meandering shaded roadways and flowery foot-paths. The framework of the volcano, which will require for its construction 18,000,000 pounds of iron and steel, will be covered with a crust of vegetable mould. The perpendicular parts will be decorated with rocks formed of cement, so as to give the whole an Alpine aspect. The earth that covers the framework will be turfed, in order that the mountain may present a verdant appearance.

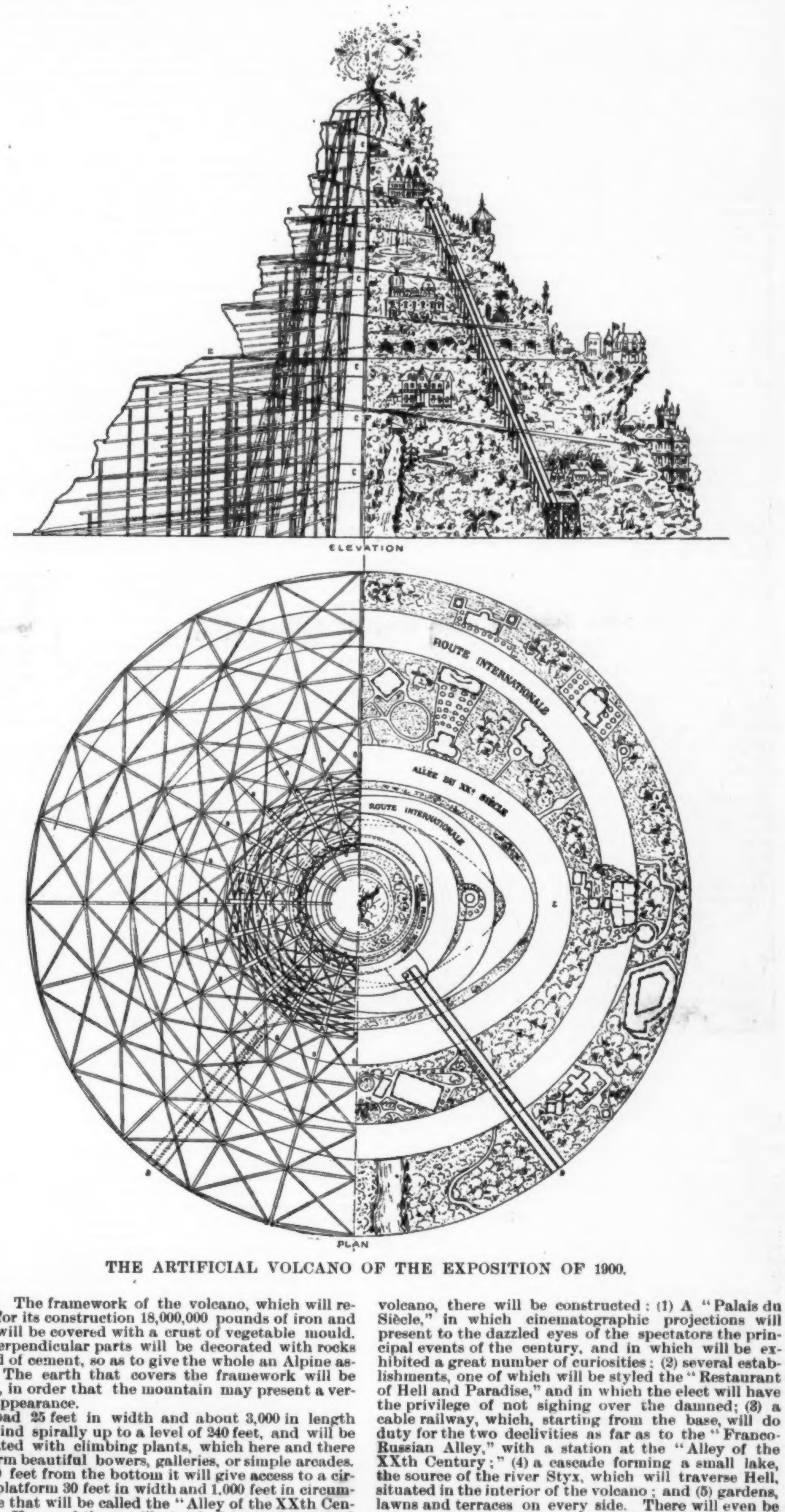
A road 25 feet in width and about 3,000 in length will wind spirally up to a level of 240 feet, and will be decorated with climbing plants, which here and there will form beautiful bowers, galleries, or simple arcades. At 120 feet from the bottom it will give access to a circular platform 30 feet in width and 1,000 feet in circumference that will be called the "Alley of the XXth Century." Here and there will stand clumps of trees and masses of Alpine plants that will recall the luxuriant vegetation of the Mediterranean Alps. At 240 feet the "International Road" will lead to another platform 30 feet in width, but only 328 feet in circumference, which will be named the "Franco-Russian Alley." The trees that decorate it will be somewhat stunted, so as to imitate nature perfectly; but the general appearance will be none the less pleasing. The vegetation will die out only at the very mouth of the crater. Here and there along these sylvan roads will be placed chairs and benches.

In addition to these main highways, there will be secondary roads and paths that will lead to various public establishments, such as cafes, bars, restaurants, concert halls, etc., in order that the civilization of the plain may mingle intimately with the primitive nature of the high summits.

The culminating point will be nearly perpendicular, in order that the eruption of the Parisian Vesuvius may be better contemplated.

Upon the circumference, properly so called, of the volcano, there will be constructed: (1) A "Palais du Siècle," in which cinematographic projections will present to the dazzled eyes of the spectators the principal events of the century, and in which will be exhibited a great number of curiosities; (2) several establishments, one of which will be styled the "Restaurant of Hell and Paradise," and in which the elect will have the privilege of not sighing over the damned; (3) a cable railway, which, starting from the base, will do duty for the two declivities as far as to the "Franco-Russian Alley," with a station at the "Alley of the XXth Century;" (4) a cascade forming a small lake, the source of the river Styx, which will traverse Hell, situated in the interior of the volcano; and (5) gardens, lawns and terraces on every side. There will even be a fire engine house, although, of course, the volcano will be numbered among those things that will not allow themselves to be extinguished!

As for the summit, that will always be surmounted



THE ARTIFICIAL VOLCANO OF THE EXPOSITION OF 1900.

by a cloud of smoke. In the evening three eruptions will take place at fixed hours, and the spectators will be able to witness the incandescent lava flowing in expressly prepared channels, and the illusion will be complete.

We now pass to some other attractions which the public, desirous of seeing the eruptions or of climbing the mountain, will have at its disposal. In the interior there will be a reproduction of Dante's Inferno and of Paradise—a transparent sphere, with the motions of the stars and constellations. Openings formed in the principal alleys will give access to a revolving gallery 13 feet in width and 410 in circumference. It will be placed at a nearly equal distance from Hell and Paradise, in which a large number of figurants will give life to the sad or cheerful, dark or sunlit tableaux.

PATENT SYSTEMS OF THE UNITED STATES AND FOREIGN COUNTRIES COMPARED.*

By W. CLYDE JONES.

THE possession of a patent system is the highest test of the civilization of a people. The last species of property to be recognized is the product of the intellect, that intangible subject-matter the right to ownership in which cannot be physically asserted, but must rest in the recognition and good will of the populace. Before the dawn of civilization, the last act of semi-barbarism in the progress of a nation toward the light is the granting of patents for inventions by royal gift or legislative enactment for a money consideration, and the first act in the early morning of civilization is the establishment of a uniform patent system accessible to all, whereby the patent is granted for a limited term in consideration of the eventual gift of the invention to the public. Tried by this test, China stands just below the line of civilization and Japan has within a few years risen above it.

In China patents for inventions can be procured only by royal grant and for a considerable influence and money outlay, while Japan, closely following the successful termination of the war which marked her break from the semi-barbarian past, has joined the modern nations by the adoption of a patent system. It is interesting to note in the case of Japan how the nation had made a considerable advance in the adoption of the materials of civilization before it awoke to the grander idea of the right of property in the product of the mind. Travelers in Japan, a few years ago, tell us that the disregard or lack of conception of this idea of right of ownership had proceeded to such a stage as to lead the Japanese artificers not only to copy the manufactures of foreigners, but to copy and adopt their name plates and personal marks of identification as well. But Japan has now taken the final step that carries her full into the sisterhood of enlightened nations by her formal recognition of the right of ownership in the produce of the mind.

The evolution of the patent system among nations has been toward the growth of the patent privilege and the removal of restrictions in its grant and enjoyment, and the principal nations of the world have advanced far in this direction, while the United States stands pre-eminently first and foremost. During its brief life, as the life of nations is reckoned, the United States has given to the world in number of inventions more than any two of the other nations, and, as for quality, the steamboat, the cotton gin, the sewing machine, the telegraph, the telephone, the phonograph, the commercial arc lamp and the incandescent lamp form a list which cannot be approached by any other nation, and in connection with which but one nation, Great Britain, with the steam engine, the railway and the Bessemer process, is worthy of mention.

From the recognition of ownership in the first crude weapon to the recognition of property in patents and copyrights is a long journey, and they are as far removed as the club of the savage from the machine gun, the log canoe from the Oregon, or the savage's grunt from the poems of Shakespeare.

The patent system of the United States is the result of the enactment of Congress, founded on the clause of the Constitution authorizing the encouragement of science and art by the granting of patents and copyrights, for limited periods, to inventors and authors. The spirit of our patent system is, however, derived from that of Great Britain, improved in many particulars, and the patent systems of the other foreign countries are modeled after that of Great Britain, with the frequent embodiment of more or less of the characteristic features of the system of the United States. While it cannot be questioned that the systems of foreign countries contain some points of advantage over our own, the patent system of the United States, by its remarkable and unequaled success, must be admitted to possess, as a whole, advantages over all other systems. It is worthy of note that the amendments in the laws of foreign countries have rather been a departure from the mother system of Great Britain and an approach to the system of the United States.

In the very early days, when England began to awake to the importance of her growing foreign trade, the little island, begirt with harbors from which her ships sailed out in all directions, sought to encourage manufactures and industries within her borders, as these she recognized to be the foundation of trade. In order to spur her fearless traders to penetrate every corner of the earth, patents of monopoly were granted, not only to those who should from the recesses of the mind bring to light new inventions, but also to those who by their travels abroad should learn of an art or industry and who should introduce the knowledge thereof into England. A system of monopolies was thus built up, which, in effect, parceled out the trade of the nation to various monopolists, each exclusively controlling some particular branch of industry, like the sale of salt, tea, and the like. These monopolies led to abuses and the corruption of government, as is usually the case with prolonged franchises, and, finally, a law was passed wiping out all monopolies, and providing only for the grant of patents for a limited period to the producer or importer of a new invention or discovery. England thus retained the feature wherein patents are granted to one who introduces the knowledge of the invention into England, even though he be not the first inventor, and this feature is present in the English patent system to-day.

* Read before the Chicago Electrical Association, March 3, 1899.

In the drafting of the American patent system our forefathers wisely omitted this feature, and provided for the grant of patents only to the first and original inventor. This provision encourages the effort to construct something new, rather than to spend time in trying to find and appropriate what has been previously discovered by others; and, moreover, it removes a very enticing incentive to mental theft. Franklin invented his famous open stove, and in the spirit of philanthropy which pervaded that great benefactor, determined to give the benefits thereof freely to the public, but the patent laws of England circumvented him, and an iron founder took out a patent on it in England and made a small fortune in vending it.

A few of the foreign countries have followed the example of England in this respect, while others, as Germany, France, and Belgium, have followed it to a degree, since they grant the patent to anyone who applies for it, but, if contested, the patent will be declared invalid if it appears that the patent has been granted upon the invention of another without his consent. The patent is thus not prima facie evidence of validity of title. In the United States the patent will be granted only to the actual inventor, or at his request to his assignee, but the oath of the inventor to the effect that he believes himself to be the first and original inventor is a prerequisite to the grant of the patent. Some of the countries, as Sweden, Norway, and Denmark, follow the practice of the United States in this respect.

While as to this feature of granting the patent to first to apply, England and the other countries mentioned are more liberal in the grant of the patent, it is not a liberality in favor of the inventor, but is rather a hindrance to his proper enjoyment of his rights. The American plan is evidently the more logical and just, and this fact is evidenced by the adoption of the spirit of the American idea by most of the other countries, among which may be included the colonies of Great Britain, each of which has its own patent system.

As to the remaining points of difference between the patent systems of the United States and foreign countries, it will be found that they reside in certain assistance which the United States gives to the inventor which the other countries withhold, and in certain restrictions to the enjoyment of the monopoly imposed by other countries which are absent in our system. The United States system thus offers the greatest encouragement to the inventor by assisting him to determine the true scope of his invention and by placing the fewest obstacles in the path of his enjoyment thereof, after the procurement of the patent.

The principal difference between the patent systems of the United States and foreign countries may be enumerated as follows:

1. The United States protects the inventor by granting the patent only to the first and original inventor, while some of the foreign countries grant the patent to the first to apply.
2. The United States provides an examining corps to assist the inventor in determining the state of the art and the true scope of his invention, whereas most of the foreign countries grant the patent as requested without inquiry as to novelty.
3. The United States gives to the inventor a preliminary period of two years within which to try his invention by public use to determine its practicability and value, before applying for a patent, while in foreign countries the knowledge or use of the invention in the country prior to the application invalidates the patent.
4. The United States places no requirement upon the practicing or working of the invention, while foreign countries usually require the putting of the invention into practical operation within a definite period.
5. The United States places no restriction upon the importation of the patented device, whereas such restriction is imposed by some of the foreign countries.
6. The United States requires the payment of no taxes after the grant of the patent, whereas the foreign countries usually exact a yearly tax or annuity, increasing from year to year, the failure to pay which causes the forfeiture of the patent.
7. In some of the foreign countries a compulsory grant of licenses is provided for, where the patentee refuses or is unable to fill the demand for the article, while in the United States compulsory licenses are not provided.
8. In the United States the term of the patent begins to run from the grant of the patent, while in the foreign countries the term usually dates from the filing of the application.
9. Some foreign countries provide that the domestic patent shall expire with the first foreign patent to expire on the same invention. About a year ago a similar provision in the laws of the United States was repealed.

Besides the above there are many differences of minor importance.

The first distinction referred to above has already been discussed.

As to the second, the examining corps, as provided in the United States, comprises a number of trained experts experienced in the various lines of industry, who, upon the filing of an application for a patent, examine into the novelty of the invention and make a report thereon. The letters-patent are in the nature of a contract between the inventor and the government, the consideration flowing from the inventor being the complete disclosure of his invention, so that the public may enjoy it after the expiration of the patent, and the consideration on the part of the government being the grant of an exclusive monopoly to practice the invention for a term of years. The examiners are, in effect, attorneys for the government, and the application for a patent is in the nature of the first draft of a contract which is submitted for their consideration. In the application the inventor outlines the scope of the monopoly to which he believes himself entitled in view of the prior art as the inventor understands it. If, in his examination, the examiner discovers prior patents, publications or uses which render the real invention narrower than the inventor supposed, he is called upon to redraft his claims, which set forth the essential novelty of the invention. By amendment the inventor brings his claims to the scope commensurate with the state of the art, and as thus amended the application matures into the letters-patent. If the examiner finds no novelty in the invention, the application is rejected upon the cited instances of prior invention. From an adverse decision of the examiner an appeal lies to the Board of Examiners-in-Chief, consisting of three judges, and from their adverse decision appeal may be taken to the Commissioner of Patents, and from his decision to the Court of Appeals of the District of Columbia. As a final resort the inventor may bring a bill in equity in the Federal courts to compel the Commissioner of Patents to issue the patent. The inventor thus has ample recourse if he considers the action of the examiner erroneous.

Germany has adopted the American system of examination as to novelty preliminary to the grant of the letters-patent, as have also to a degree Canada, Denmark, Sweden, and a few other countries. With the exception of Germany, however, the examinations are not rigid or efficient.

In Great Britain, France, and Belgium no examination as to novelty is made, and the letters-patent are granted upon the application as filed, if the papers are formal. The result is that the patentee does not know whether his patent covers a novel invention or one which has been repatented a number of times. An examination of English patents discloses the fact that the same invention is repeatedly patented unknowingly by different inventors, and such subsequent patents are, of course, invalid. If he would know whether or not his invention is patentable, he must determine by a private examination at considerable expense what the government by the division of labor could perform for a merely nominal sum.

The examining system, however, presents in practice one objection which is avoided in the English system. In the American system the inventor's rights are determined by the language of the claims which he accepts in his patent, and if he accepts claims narrower in scope than he might have obtained, he is held to have abandoned what he fails to claim. An unskilled attorney or an obstinate examiner may thus lose to an inventor the true fruits of his invention. The failure of the inventor or his attorney to claim all he was entitled to claim, or the refusal of the examiner to allow a claim as broad as the inventor considers his invention to support, frequently results in the issuance of a patent which fails to secure to the inventor his just rights. In England the patent is granted for that to which the inventor considers himself entitled, and the patent when litigated is usually sustained for so much of the invention as appears from the evidence to be novel, the patent being thus more or less elastic in its nature, broadening or narrowing to meet the true measure of the inventor's real invention.

While the English system is advantageous in this particular, the advantage is greatly overborne by the fact that the issuance of a patent is not a prima facie proof of novelty or validity, while in the United States, where examination is made, the inventor when he receives his patent knows the scope of his invention and is able to judge of its validity. In the English system the inventor receives no more assistance in this regard than though the patent had not been granted. Nor is the liability of receiving too narrow claims by the American system the fault of the system. The inventor or his attorney should present claims commensurate with the true scope of the invention in view of the prior art as disclosed by the examiner's search, and if the examiner is considered obstinate in his refusal to allow the same, the inventor should avail himself of his right of appeal. Where an evident mistake has been made by the inventor or his attorney through accident or inadvertence the mistake can be corrected by reissue if timely application therefor is made. The best evidence of the efficiency and advantage of the examining system is that the foreign countries are one by one adopting this practice; and, moreover, inventors, foreign as well as domestic, avail themselves of the efficient corps of examiners in the United States Patent Office to determine the real scope of their inventions and then apply for patents in the foreign countries on the inventions as developed in the United States Patent Office.

Considering the third of the above-enumerated differences, the foreign countries do not permit the knowledge or use of the invention to become public within their borders prior to the application for the patent. Such prior knowledge or use does not preclude the grant of the patent, but the patent when granted is invalid, and if contested, this fact being proved will prevent recovery for infringement. The United States wisely provides a probationary period of two years within which the inventor may use his invention in public and introduce it into commercial use, if he sees fit, to try the demand and determine whether or not it is successful mechanically and commercially. He may then go into the Patent Office and secure a patent on his invention. This provision is not only an assistance to the inventor but is a benefit to the public, since it does not compel the inventor to rush into the Patent Office with a crude idea, but encourages him to wait until he has demonstrated the practicability of his invention, when by disclosing such a structure in his letters-patent he gives something of real value to the public.

As to the fourth difference above referred to, the foreign countries, with the exception of Great Britain, usually provide that the invention shall be worked or put into use in the country within a certain period after the application is filed, usually from one to three years. This is a hardship to meritorious inventors, since it is often difficult for a poor man to enlist capital in so short a time to place the invention in a marketable condition before the public, and fails to reach the parties at whom it is apparently aimed. Parties who are placing an inferior article on the market frequently make improvements which would greatly benefit the public if placed on the market, but such devices when patented and thus withdrawn from the use of the public generally are shelved, since there is more profit in the sale of the inferior articles. These provisions contemplate the forfeiture of the patent for failure to work such inventions; but the intent of the law is readily circumvented by the practicing of the invention on a small scale at stated intervals to comply with the requirements of the law. Such provisions, therefore, while apparently failing to operate effectively where they would serve to advantage, impose a very material obstacle in the path of the struggling and usually meritorious poor inventor.

Considering the fifth difference, relating to importa-

tion, the United States places no restriction upon the enjoyment of the invention in this particular, and a foreigner after taking out a patent in this country need not manufacture here, but can manufacture abroad and import the articles into this country to supply the demand here. This, of course, is an economic disadvantage to this country and is a derogation of the rights secured to home manufactures by a protective tariff, but is an illustration of the respect paid to patent property.

Referring to the sixth difference referred to, the foreign countries usually provide for a graduated tax payable yearly throughout the life of the patent and increasing from year to year, so that the patent becomes an increased burden as its life is prolonged. The spirit of this provision is to spur the inventor to reap a reward from the invention as soon as possible by putting the same on the market and thereby giving the public the benefit thereof, and to discourage the prolongation of the life of the patent when the invention is not put into public use or has not proved remunerative. This is another of the provisions of foreign countries tending to discourage the inventor by placing obstacles in his path. To wealthy parties the tax is not a burden, and while the real injury to the public arises from the withholding of important inventions from the public while being supplied with inferior goods in which there is more profit to the maker, these taxes do not attack this evil, as is their evident intent, since such parties are abundantly able to pay the consideration necessary for withholding the invention from the public, and the whole burden of the provision falls upon the poor inventor, who, in addition to the difficulty of enlisting capital to exploit his invention, finds himself in constant danger of losing all of his rights by failure to raise the necessary amount to pay the frequently recurring taxes. The patent system is the fortune field of the poor inventor, and while a heavy tax upon unused inventions would undoubtedly be an advantageous provision if discriminately applied, it seems that the only effect of a general provision to this effect is to work a hardship upon the very inventors who should rather be given assistance.

Adverting to the seventh distinction above mentioned, we find that some of the countries, particularly Germany and Canada, provide for a compulsory license where the inventor or owner of the patent does not or is unable to supply the market. In Germany any party wishing to utilize a patented invention which is not being put upon the market to supply the demand or a probable demand can apply to the government for a compulsory license, which, in proper cases, is granted by the government after the giving of proper guarantees and security for the payment of royalties. This is apparently a good provision, and might be applied to advantage in this country.

As to the eighth difference mentioned, the practice of the foreign countries is to limit the term of the monopoly from the date of the application, whereas in the United States the term begins to run from the date of the grant of the patent. Where no examination as to novelty is made, the practice of the foreign countries is undoubtedly a proper one. Where, as in the United States, examination as to novelty is made, often necessitating appeals and long delay, such a provision would be manifestly unjust, since the course of appeal frequently occupies a number of years, while several years is not infrequent in the absence of an appeal, due to the overworked condition of the examining corps. Then, too, several applications, claiming the same invention, necessitate the declaration of an interference to determine who is the first inventor, and this process, subject to many appeals, consumes considerable time, so that if the term were to date from the filing of the application a considerable period of the term would often elapse before the commencement of the monopoly, and this, frequently, without fault on the part of the applicant.

But, on the other hand, the United States practice often results in great injustice to the public, by permitting an application to lie in the Patent Office for a long period of years, while another and former patent is securing a monopoly, to issue at last just as the earlier patent is about to expire, thus securing an increased monopoly for practically the life of a new patent. Such an instance is the now famous Berliner case, the injurious effect of which upon the public and upon our patent system has not as yet been determined. Since it is apparent that it would be unjust to the inventor, on the one hand, to adopt the foreign practice and limit the term from the date of application, and since the present practice is, on the other hand, unjust to the public, it has been proposed to adopt a mean between the two and provide for the running of the term, as at present, from the grant of the patent, but to provide that in no case shall the monopoly extend beyond a period of say 20 years from the filing date of the application. This would give three years for the prosecution of the application, and would seem to solve the present difficulty.

The ninth difference is one which arises from a law which went into effect in the United States the first day of January, 1898, and which provides, in effect, that the life of the United States patent shall not be affected by the previous expiration of a foreign patent for the same invention, whereas prior to that date in the United States, as well as at present in many foreign countries, the foreign patent first to expire determines the life of the domestic patent. The spirit of this provision seemed to be that since the monopoly is in the nature of a tax on the public, the removal of the tax in a foreign country by the expiration of the patent there would subject this country to a disadvantage, and that in consequence the tax should be removed here at the time it is removed from the first of the foreign countries. But this would hold good only in case patents were taken out in all the foreign countries, which is practically never the case, so that the argument is apparently not sound, and after wondering for some time what was the real advantage of the provision, and concluding that it really had no reason for existing, Congress repealed this restriction to the proper enjoyment of the monopoly by the inventor.

It is thought that it will appear from the above that the system of the United States is the most liberal to the inventor, in that it not only assists him to determine the scope of his invention, but also removes all checks from his enjoyment of the monopoly. While it is apparent that in our system some objections and abuses may arise, they are not due to the general provisions of the system, but rather to the lack of specific provisions for checking the particular abuses, and these will, it is believed, be in time remedied, but not by radical changes or the adoption of the cumbersome provisions of foreign systems, although we may derive suggestions from their practice. As to the practical effect of the American system, a comparison of the patents granted by the United States and foreign countries shows that up to the year 1898 the United States had granted 626,327 patents, France 297,166, Great Britain 265,870, Belgium 146,772, Germany 118,694, Austria-Hungary 82,933, and Canada 65,489. The United States thus stands head and shoulders above all the other nations, having granted more than any two of the other countries.

During 1898 there were over 36,000 applications for patents filed in the United States, while in Great Britain there were about 30,000 applications filed. Practically, all of the applications in Great Britain mature into patents, many of which are invalid by virtue of previous patenting, since no examination as to novelty is made. During the year 1898, 22,207 patents were issued in the United States, after examination, and at the end of the year there were 6,824 applications allowed and awaiting the payment of the final fees, while 4,363 applications had been allowed, but had been forfeited for the non-payment of the final fees.

Just how much of the great activity of American inventors is to be attributed to the encouragements offered by our liberal patent system and how much is to be attributed to the inherent inventive faculty of the American people cannot, of course, be mathematically determined, but it is safe to say that the rewards offered by our system have been the fundamental cause which has produced, as a result, a people every member of which is a born inventor and is accustomed to the practice of mechanical ingenuity from early childhood.

CURIOUS CUSTOMS OF THE ISAWIYAH.

IT was a warm winter night, with a blazing moon at the zenith—a moon that bathed everything in a haze of mellow turquoise green. The whitewashed mud walls of the village, which straggled up a bare hillside, shone with phosphorescent light, and at the top of all the domes and cupolas of a great mosque glowed pale green against the darker green of the sky. Now and then there flitted along the walls a deep indigo shadow, cast by some passing figure with pale, shrouded head and white burnous—itself almost invisible against the whitewashed walls. Only at rare intervals the dazzling brightness of the turquoise town was broken by the formless blot of a doorway or window or the uncanny growth of huge prickly pears.

The mosque of the Isawiyah was not the big one which crowned the height, but a little squat-domed building on the outskirts of the village. Already round the door was gathered a crowd of solemn Arabs; we went through the doorway down into a little white moonlit courtyard, and from that, with a whispered hint from our host to suppress our sense of humor, down more steps into the mosque. The length of the buildings was at right angles to the doorway, opposite which was a small apse where seats were put for us. In this way we were cut off from any possibility of exit by the whole congregation—an arrangement which made us hope that the spirit might not work too mightily that night. From the low whitewashed domes hung colored lamps of tawdry metal and glass. From end to end of the building sat cross-legged on the ground a double row of singers and musicians, and behind these stood the line of dancers on whom the chief burden of the ceremony fell. Seated as we were behind the musicians, we looked over their heads at the faces of the dancers. Between the second row of the musicians and the long line of dancers was left an open space in which at some distance apart stood two men whom I will call stewards; these neither danced nor sang, their duty was to remain impassive, the sole depositaries, as it were, of the standards of ordinary life. It was an office for which we felt grateful in the paroxysmal orgy that followed.

The light of the hanging lamps and of a row of candles placed between the singers on the floor threw a warm, yellow glow on the dusky vaulted roof, which faded into gloom at either end. But the dancers were in a blaze of light, and the line of white, swathed figures, their red turbans and even their dark features cut a sharp ever-changing silhouette on the darkness of the aisle behind and the night sky seen through the open door. Dusky ocher, white, and red were the dominant tones of the whole, but among the elder men, who sang or merely looked on, were some rich gandaras of turquoise and pale green, others of violet, puce, and scarlet.

WEIRD CHORISTERS.

When everything was ready the music began. All Arab music is strange to European ears, but the Isawiyah has a system of religious inharmony of its own, in which the peculiar nasal discords of Arab music are exaggerated to an exasperating pitch, while the rhythm is as complex and as frenzied as the dance which it accompanies. The singers and musicians were mostly elderly men in whom the youthful ecstasies of self-immolation had given place to soberer and maturer joys. The tambourine was the only instrument, and as they played all sang words from the writings of Sidi ben Isa. I call it singing, but the tense and painful expressions of these elders, the corners of their mouths drawn down, the eyes screwed up to mere slits, and heads strained upward, resembled that of a row of fierce animals serenading the moon in the desert rather than a church choir. The only exception was the holy man sitting just opposite to us, in whose face, beatified with the religious exercise, was reflected the light of a heavenly vision, unmarred for him by the fact that his private life, like that of some European saints, was not entirely free from reproach. Meanwhile the tambourines rattled incessantly with a dull, wooden sound; the ictus of the rhythm was marked by the holy man's lifting his tambourine above his head with a sudden jerk and giving it a violent thump from below, while he gazed up at it as though its dirty parchment covered an imminent paradise.

As the music grew faster and more orgiastic the dancers became more and more violent. Standing shoulder to shoulder in a close-packed line, each grasped his neighbor's hand held rigidly down against the thigh. The basis of the dance, which continued with scarcely any intermission for the whole two hours of the service, was a rapid jigging up and down of the line of dancers, the bodies being kept straight and stiff, and only the heads wagging limply from side to side with the movement. In the center of the line stood the leader, the elected president of the sect, a handsome, finely built youth of about twenty, who had been engaged all day in making our host's new croquet ground. He it was who marked the changes in the dance by leaving the line, spinning round on his heels, and clapping his hands above his head. At a sign from him the whole line would bend their bodies forward till their heads nearly touched the ground, with scarce a moment's pause in the interminable jig.

As the music rose to a crescendo, and the rhythm became more frantic and involved, the dancers got visibly more excited and less conscious of their surroundings, their eyes taking on a fixed and vacant expression. Then the leader of the dance applied what seemed to be the most effective and culminating intoxicant; at each ictus in the dance all the heads were strained forward and every one gave a deep staccato groan, like the roar of a wild beast, while the blood rushed to the head, and the muscles of the neck were strung like ropes under the strain. It was not long before this produced the results for which all were waiting. A man of about thirty, wiry and thin, with a small head, tore himself from the line of dancers and rushed up to one of the two stewards standing in the open space. The steward unwound his turban and held him for a moment in a fraternal embrace. With his turban the man seemed to have doffed most of his humanity; his small face, almost covered with black hair; his bristling whiskers, his blue shaven scalp, with the little pigtail of black hair flapping behind at every movement; above all, the lips stretched across his large white teeth, like those of a snarling dog, all gave the impression of something ultra-human—at once sublime and bestial.

Then, bent nearly double, feeling with outstretched arms, blinded by his ecstasy, he groped his way down the open line between dancers and musicians to the other steward. This man held in one hand a large cloth filled with pieces of broken glass; one of these he took out and held in his right hand at arm's length. The ecstatic as he approached glared savagely at the glass, gnashed his teeth and stretched out his head; but he drew back; the religious intoxication was not quite complete, and some glimmerings of common-sense standards still struggled in his disordered brain. He rushed back to the first steward, was again embraced by him and again crept back along the line. Still the jagged shining glass was too terrible. Backward and forward he went, sometimes groping along slowly, sometimes with the stealthy rush of a tiger stalking its prey. At last, when the eager gesture of his outstretched neck made it clear that no vestige of reluctance remained, the steward clapped the glass into his mouth and held his hand over it for a second. The devotee rushed back as it were for consolation to the first steward, and held him in a tight embrace. For some time he remained so, making strange, incoherent gestures with his arms, while the steward, gradually lifting up his head, proceeded to massage his face and throat; when his head was raised the man was still chewing and swallowing the horrible mouthful. After he had recovered himself somewhat his turban was wound round his head and he was lifted and shoved back into the line of dancers, where he went on jigging up and down, his head falling now on one shoulder, now on the other, with a blank, listless look in his face.

After this first example of frenzied devotion the spell of fear seemed to be broken, and one after another the dancers left the line (the dance never ceasing for an instant, and the music keeping up its maddening din) and rushed at the steward who held the glass and dealt out piece after piece. Soon even the boys took part in it, and one handsome fellow of sixteen came up and stretched out toward the jagged morsel as though it was for him the bread of life. For the most part, too, they seemed to chew and swallow it with increasing ease, and the first steward had little to do but wind on their turbans and put them back into the line of dancers. Then the man who had first eaten, and who had meanwhile recovered his tone, came back for a second, and a little while after for a third, mouthful, but the frenzy was increasing upon him, and he had to be held by three or four Arabs, who rushed up from the sides to help the steward. It became a football scrimmage, and the four men had to put out all their strength to collar and throw him. Finally he was held down on the floor in a sort of epileptic fit, throwing his limbs about wildly, and literally barking like a huge dog. The divine ecstasy was too much for him and he had become a savage beast.

Nor was he the only one who became unmanageable under the intoxicating influences of dance and music. Sometimes, it is true, when a devotee was exceeding the usual bounds, his growing excitement could be instantly assuaged by a few words from the writings of the saint whispered into his ear by the steward; but in spite of this several broke loose, and one in especial alarmed us by making his way round the mosque toward our party. Fortunately, he was thrown and sat upon by assistants before he reached us, as it is supposed that an Isawiyah will tear women in pieces when too powerfully worked upon by the divine influence. When the service was over, and the mosque gradually emptied, we saw three or four of these victims of the divine frenzy lying about on the floor, by that time quite calm and exhausted, and only groaning and barking fitfully.

Finally the glass-eating came to an abrupt end, and in a curious way. A peculiarly fierce-looking and athletic Arab, who had for some time been developing more and more religious frenzy, and had eaten glass once or twice without diminishing his desire for it in the least, sprang at the steward—who resisted in vain—seized the cloth in both hands, buried his face in it, and munched up the remainder.

EATING NAILS AND CACTUS LEAVES.

And now the other wonders began: First, a number of carpenter's nails, at least three inches long, were handed to the steward, and a demure little man

stepped forward. He did not belong to the athletic and savage type of the majority; he was quiet and domestic, a man whom in Europe one would have ascribed to the class of small shopkeepers; but he had a look of calm contentment, a conviction of divine peace in his soul, which contrasted with the purblind excitement of the others. Nor was his ordeal a less trying one than that of glass-eating. He stood quite still, held his head back and swallowed three of the large iron nails, heads and all, as they were put into his mouth one after another by the steward.

Then he retired, and two men came in with a burnous full of prickly pear leaves. The prickly pear as one sees it in the south of Europe is a sufficiently formidable plant, but in North Africa it grows to far larger proportions; the leaves, or rather the flat leaflike stems, grow to nearly twice the size that they do in even Sicily, and the prickles are proportionately long and stubborn. Moreover, the prickle is slightly poisonous and leaves a festering wound. Consequently, it seemed not the least miraculous event of the service when a dancer stripped to the waist, and, taking a huge prickly pear leaf in each hand, proceeded to rub them all over his naked body and shaven head, using them as one might use a loofah. There could be no mistake about it that he pressed them against his skin with all his might, and in the fury with which he did it, tore leaf after leaf into pieces and took a fresh one from the heap. Sometimes he would seize one leaf with both hands and scrub it backward and forward over his bare scalp, and finally eat the leaf with all its deadly prickles. Scored and scratched as his body must have been in every direction, there was scarcely a trace of blood. This was so also with the glass-eaters, who never bled at the mouth while they were chewing the glass, and shows, I think, that the bodily functions are modified under the influence of religious intoxication much in the same way as they are in extreme states of hypnotic sleep; that it is, in fact, a very curious case of auto-suggestion, and that these men not only did not feel pain, but that their bodies were not injured as they would have been had they attempted such things in cold blood.

Next morning I looked out of my window and saw the leader of the Isawiyah rolling our host's croquet ground as usual, and in the afternoon we went down to the village and met the swallower of nails and the prickly pear man going about their business as though nothing had happened to upset them.—The Cornhill Magazine.

A DRAWING TRACED BY FIRE.

THIS amusing experiment consists in lighting a match and blowing it out in such a way as to leave the

A DRAWING TRACED BY FIRE.

head incandescent and then applying the latter to a sheet of prepared paper. The paper ignites at the point that is touched, and the fire, following a definite path, forms a design in the paper where nothing before was apparent.

The experiment is very easy to perform. First, make a cold saturated solution of saltpeter, and then, having procured a sheet of thin paper, draw upon it any sort of a design with a splint of wood or a quill pen dipped in the solution. The lines of the drawing should be rather heavy. After the paper has become dry, all that is necessary is to apply a light to some point of the drawing, as above mentioned.—Tissandier, in La Chimie sans Laboratoire.

THE NORTH AMERICAN PORCUPINE.

By Dr. G. ARCHIE STOCKWELL, F.Z.S.

OF all the creatures that pertain to the class vulgarly denominated "gnawers," and by naturalists relegated to the order Rodentia, there is no one group thereof possessed of greater interest than the family Hystricidæ, which embraces not alone the porcupines proper, but also the familiar insectivorous hedgehog common to the gardens of Great Britain and middle Europe. Strange to say, the latter is, among the ignorant, frequently denominated a "porcupine," though there is little in common between the two except a defensive armor of spines. The habits of the hedgehog are familiar to nearly every boy in England or France; but no such information obtains to the porcupines, not even in districts inhabited by the latter. Indeed, for a group so widely and generally distributed—there is scarcely a region outside of the Arctics and sub-Arctics that does not harbor one or more species—there is very little known of the life habits of these creatures, lack of accurate information being substituted by idle and vulgar tales or absurd traditions; undoubtedly crepuscular or nocturnal habits have to do with some of these. There are many that implicitly believe the idle tale that these creatures, when put upon the defensive, possess the power of hurling their quills to considerable distances; that the young, when born, are invariably two in number, one of which is stillborn and the survivor weaned on the sap of the sugar maple or beech; that the thirst of the young porcupines is quenched by water brought to the den by the mother in the hollows of the quills of her tail; that all the species run obliquely backward to meet the assaults of an enemy, whom they seek to transfix with their quills; and finally, that the Canadian variety "lay eggs"—a conclusion arrived at as the result of the belief that the young, when first ushered into the world, are invested with complete armor, the possession of which would be apt to seriously interfere with the ordinary parturient act. The Micmac Indians of the eastern provinces are wont to declare the forlorn appearance of the porcupine is restricted solely to the hours of daylight, and is due to the fact that he is "ashamed of himself;" but that after dark he "lifts his head and runs like a dog"—a conclusion that, as Capt. Campbell Hardy remarks, may be accepted only when the porcupine is caught in the act.

The term porcupine is of itself somewhat puzzling, but is popularly believed to be the result of combining the French words "porco" and "epine," which sufficiently delineate the filthy and swinish habits and grunting voice peculiar to the creature, as well as the spiny character of its armor. This, perhaps, is as good an explanation as any.

Like most rodents, the race is characterized by an utter lack of canine teeth, and by the fact the mandible (upper jaw) never contains more than two incisors symmetrically placed on either side of a symphisis, that, being devoid of roots, continue to grow through life at the base in proportion to the wear at the crown; hence it is that if a tooth is broken, its fellow in the opposite jaw is extended to indefinite length, and, if not distorted, ultimately interferes with the acts of mastication and deglutition by rendering closure of the jaws impossible, causing slow and lingering death by starvation. So, too, with the sole exception of the hares and rabbits—both of one genera—none of the gnawers possess more than two front teeth in the premaxilla (lower jaw), which present the same precise characteristics as to growth and development as their opposed incisors; the latter, however, are more heavily coated with enamel on their anterior surfaces; consequently, by continual attrition, acquire and retain a chisel-like edge.

The molars, four in number to each side, have complete roots, the anterior pair being usually considerably larger than their fellows, those of the upper jaw with an internal fold of enamel and three or four folds entering from the opposite side, which soon assume the form of small isolated areas disconnected from the margin of the tooth. The lower molars resemble the upper, but the folds of enamel are reversed.

There are between fifty and sixty known species of porcupine classified in five, or, perhaps, six, genera. The latter embrace the common porcupine of southern Europe and northern Africa; the brush-tailed porcupines of the regions bordering the Straits of Sunda; the East Indian or Malay variety; the prehensile-tailed forms of South America; a species peculiar to Mexico and Central America, and remarkable in that no portion of the body, the soles of the feet excepted, is free from spiny growth; and finally, the two varieties indigenous to North America, viz., Erethizon dorsatus and E. epixanthus, both commonly denominated "Canadian," though neither is confined exclusively to the Dominion.

E. dorsatus is the true Canadian or brown form, and E. epixanthus the western or yellow porcupine; but the fact is they long were classed as a single species up to 1835, when they were separated by Brandt, and may yet, for all practical purposes, be considered identical, the difference being chiefly anatomical, and slight variation in the color of the tips of the hairs of the under coat that is distinctive only in the extremes of habitat. Indeed, without knowledge of the precise locality from which any one specimen is had, it is sometimes difficult even for expert naturalists to decide as to the species.

The yellow porcupine ranges from the Missouri to the Pacific, being found as far north as the upper Yukon valley and to the south to the Mexican border; it is even found in western Texas, and meets its brown relative in the vicinity of the Great Lakes of Central British America.

The "Canadian" or brown form is had from the Atlantic to the Missouri; to the north as far as Churchill Inlet and the Barren Grounds; to the south, though formerly ranging to Virginia and Kentucky, it is now scarcely known below Michigan and New York. It is most abundant in Maine and the eastern provinces of Canada. The distribution, however, is by no means uniform, and there are considerable areas which seem to be persistently shunned by this creature, particularly certain districts of Labrador and Quebec. Though found on the northern side of the Strait of Belle Isle, no porcupines have ever been met with on the opposite shore of Newfoundland. The same is equally true of the island of Cape Breton, which is separated from the mainland only by the Gut of Canso, that in many localities is not more than half a mile wide; and though it is said numerous attempts have been made to colonize them on the island, all such have been met with failure, probably for the reason that, given a porcupine in any one known locality, such constitutes an inseparable temptation to the red man, which can only be overcome by consigning the creature to the pot.

Neither the yellow nor the brown porcupine presents the cleft in the upper lip that is such a marked characteristic in all old world forms, though sometimes may be observed the least suspicion of a notch. The collar bones are well developed, as are also the shoulder blades; the acromion ends of the former send a process backward over the infraepinous fossa. The frontal bones are of enormous size, and inclose a large frontal sinus; also a suborbital foramen, through which passes an anterior fascicle of the massater muscle. The feet are distinctly plantigrade, closely resembling those of the black bear (Ursus Americanus); the soles are longer than broad, covered with pavement granulations and divided from the toes by a transverse fissure filled with hair. The balls of the toes are like the soles, naked and granular-tuberculose, though to cursory inspection they appear to possess hirsute growth, owing to the overlapping of bristles that grow at the sides of each digit. There are four distinct toes to each forefoot, about equal in length; the posterior feet have a fifth toe or thumb, which is decidedly short, but by no means rudimentary. All toes terminate with stout claws of nearly equal length and proportions.

The intromittent organ possesses a bone, the same as in dogs, raccoons, etc.; but the testes are confined to the abdomen at all times, though during the breeding season they descend as far as the groin, and then become greatly enlarged. Vesiculæ seminales and prostate gland are present, as is also the Cowperian gland, and all are, in proportion to the size of the animal, somewhat unusually developed. The uterus in the female possesses two cornua that unite to form the body of the organ, which is rather T-shaped.

In size, the North American porcupine approaches a small dog, its weight seldom exceeding twenty pounds; its length from end of snout to tip of tail is barely forty inches, of which the massive, almost four-sided, cauda claims at least one-sixth. The general hue above is a dark brown; in the Western variety, a yellowish brown, shading toward black, and upon the inside of thighs and under parts generally merges into an ashen hue. The colors may vary considerably in different specimens, according to age and source from which derived, but the one description of characteristics will in the main fit both the Eastern and Western forms.

When divested of quills and bristles, leaving only the fine under-fur, the pelage presents a seal brown hue, and at one time had a market value under the title of "spring beaver;" but the distribution of the fur upon the skin is by no means uniform, and, consequently, it no longer pays for the trouble of curing.

As intimated, the pelage exhibits three forms of hirsute growth, viz., the close under-fur, the bristles, and the quills. The latter, under ordinary circumstances, are almost completely hidden by the bristles, which frequently attain a length of five or six inches. The quills, confined to the upper parts and sides, are short and sparse on the head and neck, becoming longer on and thicker upon the back, attaining their greatest proportions on the rump and tail (four or five inches in length); upon the sides also decreasing until they are merged into coarse bristles. On the belly there is nothing but soft fur; the muzzle also is hairy, but devoid of quills.

Naturally, the spiny armor of the creature constitutes its most interesting characteristic, inasmuch as it is its sole means of defense. Ordinarily, the quills lie close to the body, and to the uninitiated give no hint of their formidable character. But let anger or fear seize upon the wearer, suddenly, to quote the words of Figuier, "a whole forest of bayonets spring up." Being of timid nature, the porcupine, when assailed, seeks refuge in some inaccessible recess in the rocks or ground or in the branches of a convenient tree, where he will remain for hours, even days; but if none of these are available, he places his head between the forepaws, erects his quills, and presents to the foe an impermeable panoply of spines. These spines or quills are, after all, the same as the nails of the human hand or foot, merely modified and agglutinated hairs. The formative pulp is longitudinally furrowed, and growth is due to the cellular pith which deposits continuously around the whole the horny cortex. Beneath the matrix is a cavity like a minute bursa mucosa, which permits of considerable individual freedom of movement to the individual quill when acted upon by the muscle of the sheath. The matrix, when the growth is complete or matured, shrinks and pushes the base of the quill toward the surface; meantime the derm end of the quill is contracted in its diameter until it adheres to the surface of the skin only by a narrow neck, below which is the slightly expanded remnant of the matrix. Thus it happens that when the quills are violently agitated or suddenly erected by the action of the panniculus carnosus muscle, the adhesion to the derm of some of the older or more matured is so slight they are at once released. Herein, taken in connection with the rapid movements of the tail, lies the origin of the superstition that the porcupine hurls its quills at will, and also the belief that it moults after the manner of birds.

Too slow to escape the attacks of predaceous creatures by flight, the spiny armor provides an efficient safeguard, aided by the quick, sidewise movements of the tail, which latter are often so rapid as to be scarcely perceptible to the human eye. Except the domestic dog, there is no animal that will attack the porcupine, save the pekan; and both the latter and the dog have learned—doubtless as the result of experience—to bide their time until the porcupine imagines his foe has retired and ventures to lift his head. Then the seizure is made, by the throat, and in a twinkling the "fretful one" is thrown upon its back, exposing its only really vulnerable part, viz., the abdomen. Wild cats, pumas, wolves, and other predaceous creatures have been known to yield their lives as the result of a too familiar interview with the porcupine, the multitude of quills embedded in nose, lips, tongue, and throat, affording abundant evidence of the fatal cause. Each quill is finely barbed after the manner of a fish-hook;

consequently, once entered into the flesh, it is almost impossible of extraction, and with every movement of the parts it sinks deeper and deeper, until finally it works out at some distant point; and naturally, the quill points create an irritative inflammation that becomes more and more acute, and ends only in suppuration or extrusion. The only safe method of getting rid of the quills is to cut them off, by means of scissors or a sharp knife, close to the flesh, leaving the barbs and points to work out, which they will gradually do. I have known the stock of a gun, employed to stir up a porcupine, completely filled with quills as the result of a single sweep of the creature's tail.

Messrs. Audubon and Bachman relate the accident that befell the mastiff of a neighbor. The dog had a nasty habit of burrowing beneath fences and poaching on other preserves than those that belonged to his master. Early one morning he was seen to dash furiously upon some object, which later proved to be a porcupine owned by Mr. Bachman, and that by some mischance had during the night escaped its cage. Regardless of the threats of the latter, the intruder, who doubtless imagined this foe no more formidable than his arch-enemy the cat, sprang upon it with open mouth. The porcupine in an instant seemed to swell to double its former size, and as the mastiff approached, gave it a sidewise blow with its tail, that caused an abrupt change in the situation. The dog quickly released its hold and beat an instantaneous retreat, meantime making the surroundings hideous with his cries of fright and pain; his mouth, tongue, lips, and head fairly bristled with porcupine quills; even closure of the jaws was impossible. It was an effective lesson, since ever afterward nothing would tempt the mastiff to revisit the scene of his discomfiture. Although servants immediately extracted the quills, the dog's head for some weeks remained terribly swollen, and it was months before he fairly recovered.

It is a curious fact that dogs in general evince a strong desire to hunt porcupine, and even an experience like that of the mastiff just related is not always sufficient to deter them. Whether the rank odor emitted by the animal is particularly exasperating, or that it merely stimulates desire for the chase, is an unsolved problem. In any event, no canine possessed of real pluck and breeding can withstand the temptation. The knowing dog speedily resorts to the tactics of the pekan, being led thereto by intuition seemingly. A young bull terrier owned by the writer attacked two porcupines in one day, killing both, though the results were, so far as himself was concerned, most disastrous. His third essay was more diplomatic and successful, and subsequent efforts were simply so perfect that he did not receive a single wound. Indian porcupine dogs, in the same way, quickly master the art of porcupine hunting, and seldom give their masters occasion to extract a single quill; more, they will sometimes even enter the porcupine's den and draw him forth without injury to themselves.

The porcupine is certainly one of the most lonesome and forlorn of creatures, as well as the most filthy. The whereabouts of his den is made apparent by the strong and rank effluvium that emanates therefrom. This den is usually the burrow of some other creature, usurped and enlarged by the porcupine; or a hollow in some decayed stub or possibly a cavity among the rocks. Sometimes even the den of the black bear is invaded, when the original proprietor promptly evacuates, led thereto less on account of the spiny armor of the usurper than his uncleanly habits and unbearable odor.

On the ground this creature is clumsy and sluggish beyond all measure, but he is an expert climber of trees, exhibiting an agility quite surprising. During the day he sleeps almost constantly, especially in winter; hence has been accredited with a hibernant habit; but his winter sleep is regulated largely by the character of the weather and demands of appetite, consequently, is fitful and desultory, like that of the raccoon. The well beaten paths through the snow that lead from his den to his feeding grounds abundantly evidence this.

In summer, when he finds a tree to his liking, he may remain constantly therein until it is entirely denuded of foliage, when he moves no farther than to the next growth that promises well to his appetite. Usually the trees selected are in direct line one with another, and his path through any one portion of forest is to be traced by the devastation wrought. A single porcupine will often destroy one hundred trees in the course of a winter, and there is record of one having during five months killed and devastated three or four acres of timber.

Seldom more than one porcupine is found in the same locality; and this solitary habit is so well understood, and the creature so remarkably slow and stupid, that, as Samuel Hearne says, "Indians going to and fro often see them in trees, but having no use for them at that time, leave until their return, and should their absence be for a week or ten days, they are sure to find him within a mile of the place where he was seen before."

Besides foliage and the bark of tender twigs, such as the maple, birch and beech, in summer, and the hemlock and spruce in winter, in season he feeds upon the wild fruits, berries, and the like, and even ventures into the clearings and barrens in search thereof; he is also partial to beech nuts, acorns, and other mast, as well as garden vegetables, whereby he may become an intolerable nuisance to the backwoods farmer and pioneer. Among other things he is accredited with a sweet tooth, and tapping maple and birch trees to partake of the succulent sap thereof; also with surreptitious visits to the storehouses of lumber camps to feast upon sugar and molasses, and to the wigwams of the red man in search of the "mococks" (birch bark packages) of maple sugar. He is known to favor a birch bark diet, especially, when had in the form of canoes, through which he speedily eats holes; but he is no less partial to paint and varnish, and the modern "Rob Roy" fares no better in his presence than the more graceful handiwork of the Indian.

Water, except to quench thirst, it is needless to say, perhaps, is carefully shunned by this creature; and when drinking he laps like a dog. In winter snow affords him an excellent substitute for water.

Porcupine meat is regarded as a delicacy by most Indians, who are willing apparently to undergo considerable hardships to procure it. One can imagine when fattened on mast and wild fruits that the flesh may be fairly palatable; but in winter, when his diet consists almost exclusively of hemlock needles, it acquires a resinous flavor far from agreeable. In the season of rest, viz., during September and October, it is admittedly rank beyond expression; and at this time old males are found with bad wounds or ulcers upon the back—"the skin abraded as if from a fall out of a high tree onto the edge of a rock," says Capt. Campbell Hardy; and the red man offers the astute explanation that these arise from the efforts of the animal to rid himself from the superfluous fat resultant upon a diet of fruits and mast.

The gestative period is about seven months, and birth is given, either in April or May, to one or more, rarely two, cubs, which are very large, being proportionately thirty times the size of those of the bear; needless to say, when first ushered into the world, the offspring are both blind and devoid of quills, but rapidly develop the latter after weaning, which occurs when they are but five or six weeks old.

Porcupine quills are in great request among the Indians and even among half-breeds, their women dyeing of various colors and employing for the adornment of various articles of wearing apparel, such as hunting shirts, leggins, gaiters, moccasins, belts, garters, and shot-belts; they even use to ornament various birch-bark toys and utensils. These constitute the only really tasteful articles of ornamentation produced by the North American savage. The squaws of the Slaves, a tribe that dwell in the vicinity of the great lakes of central British America, are especially expert in the production of porcupine quill ornamentation, which for the most part assumes the form of geometrical figures or designs. In preparing the skins or bark considerable ingenuity is manifested—more than might at first glance be surmised; for the outlines are first sewed in with sinew into which the quills are woven and fastened. Split porcupine quills are often used to wrap the handles of knives and tomahawks. Specimens of porcupine-quill work are to be found in nearly every museum in the United States and Canada and will well repay careful inspection. The Academy of Sciences, Philadelphia, is particularly rich therein.

ON THE BOILING POINT OF LIQUID HYDROGEN UNDER REDUCED PRESSURE.*

By JAMES DEWAR, M.A., LL.D., F.R.S.

THE June number of The Proceedings of the Chemical Society contains a paper by the author on "The Boiling Point and Density of Liquid Hydrogen." A resistance thermometer made of fine platinum wire, called No. 7 thermometer, was used in the investigation. It had been carefully calibrated, and gave the following resistances at different temperatures:

Temperature. Deg. C.	Resistance. Ohms.
+ 99·1	7·337
+ 75·3	6·859
+ 51·4	6·388
+ 25·7	5·857
+ 0·7	5·338
— 78·2	3·687
—182·6	1·398
—193·9	1·136
—214·0	0·690

The zero of the thermometer in platinum degrees was —263·27°. Mr. J. D. Hamilton Dixon, M.A., Fellow of Peterhouse, who contributed a paper to The Phil. Mag. for June, 1898, on "The Reduction of Normal Air Temperature of the Platinum Thermometers," used in the low temperature researches of Prof. Fleming and the author, has been good enough to calculate a special formula for this thermometer No. 7. He finds the formula—

$$(R + 43·958933)^2 = 2·03596488\ (t + 1193·1460)$$

expresses the relation between the resistance and temperature in Centigrade degrees. This expression gives a probable error of only 0·16° C. over a range of more than 300° C. When this thermometer was placed in boiling hydrogen, the resistance became 0·129 ohm, and remained constant at this value. Calculated into the Dixon formula, this value of the resistance corresponds to a temperature of —238·4° C. If we assume the resistance reduced to zero, then the temperature registered by the thermometer ought to be —244° C. At the boiling point of hydrogen, therefore, if the law correlating resistance and temperature can be pressed to its limits, a lowering of the boiling point of hydrogen by 5° or 6° C. would produce a condition of affairs where the platinum would have no resistance, or become a perfect conductor. Now we have every reason to believe that hydrogen, like other liquids, will boil at a lower temperature the lower the pressure under which it is volatilized. The question arises, How much lowering of temperature can we practically anticipate? For this purpose we have the boiling point and critical data available from which we can calculate an approximate vapor pressure formula, accepting 35° abs. as the boiling point, 52° abs. as the critical temperature, and 19·4 At. as the critical pressure; then as a first approximation:

$$\log p = 6·8218 - \frac{137·9}{T}\ \text{mm.} \quad . \quad . \quad . \quad 1.$$

If, instead of using the critical pressure in the calculation, we assume the molecular latent heat of hydrogen is proportional to the absolute boiling point, then from a comparison with an expression of the same kind, which gives accurate results for oxygen temperatures below one atmosphere, we can derive another expression for hydrogen vapor pressures, which ought to be applicable to boiling points under reduced pressure. The resulting formula is—

$$\log p = 7·2428 - \frac{152·7}{T}\ \text{mm.} \quad . \quad . \quad . \quad 2.$$

Now Formula 1 gives a boiling point of 25·4° Ats. under a pressure of 25 mm., whereas the second equation (2) gives for the same pressure 26·1° Ats. As the absolute boiling point under atmospheric pressure is 35°, both expressions lead to the conclusion that ebullition under 25 mm. pressure ought to reduce the boiling point some 10° C. For some time experiments have been in progress with the object of determining the temperature of hydrogen boiling under about 25 mm. pressure, but the difficulties encountered have been so great, and repeated failures so exasperating, that a record of the results so far reached becomes advisable. The troubles arise from the conduction of heat by the leads; the small latent heat of hydrogen volume for volume as compared with liquid air; the inefficiency of heat isolation and the strain on the thermometer brought about by solid air freezing on it and distorting the coil of wire. In many experiments the result has been that all the liquid hydrogen has evaporated before the pressure was reduced to 25 mm., or the thermometer was left imperfectly covered. The apparatus employed will be understood from Fig. 1.

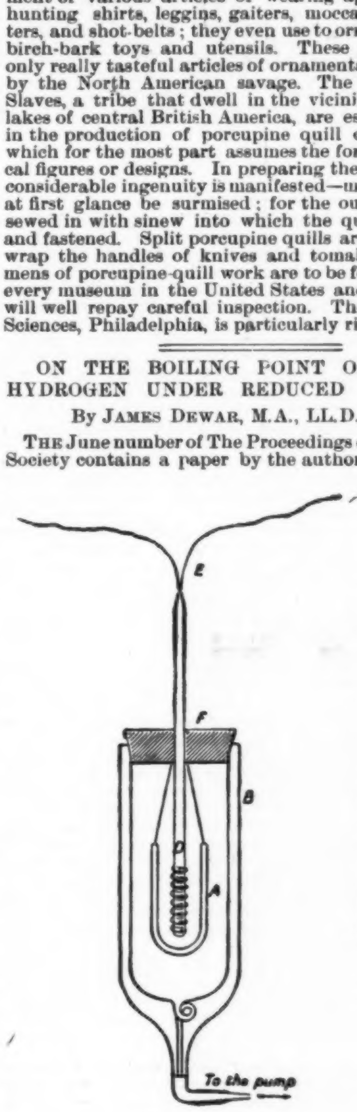


FIG. 1.

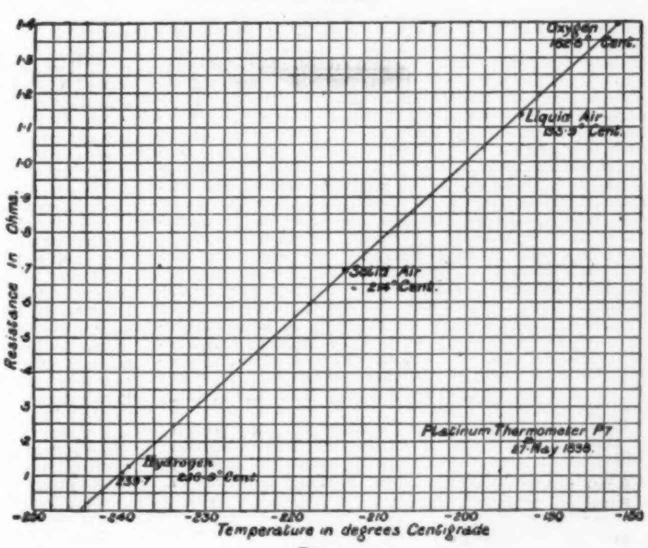


FIG. 2.

The liquid hydrogen collected in the vacuum vessel, *A*, was suspended in a larger vessel of the same kind, *B*, which is so constructed that a spiral tube joins the inner and outer test tubes of which *B* is made, thereby making an opening into the interior at *C*. The resistance thermometer, *D*, and leads, *E*, pass through a rubber cork, *F*, and the exhaustion takes place through *C*. In this way the cold vapors are drawn over the outside of the hydrogen vacuum vessel, and this helps to isolate the liquid from the connective currents of gas. To effect proper isolation, the whole apparatus ought to have been immersed in liquid air under exhaustion. Arrangements of this kind add to the complication, so in the first instance the liquid was used as described. The liquid hydrogen evaporated quietly and steadily under a pressure of about 25 mm. of mercury without the least appearance of solidification or loss of mobility; still remaining clear and colorless to the eye. Naturally the liquid does not last long, so the resistance has to be taken quickly. Just before the reduction of pressure began, the resistance of the thermometer was 0·131 ohm. This result compares favorably with the former observation on the boiling point, which gave a resistance of 0·129 ohm. On reducing the pressure, the resistance diminished to 0·114 ohm, and kept steady for some time. The lowest reading of resistance was 0·112 ohm. This value corresponds to —239·1° C., or only one degree lower than the boiling point at atmospheric pressure, whereas the temperature ought to have been reduced some 10° C., or in any case 5° under the assumed exhaustion. The position of the observation on the curve of the relation of temperature and resistance for No. 7 thermometer is shown on the diagram (Fig. 2). The question arises then as to what is the explanation of this result. Has the platinum resistance thermometer arrived at a limiting resistance about 35° Ats., so that at a lower tem-

* A paper read before the Royal Society, December 15, 1898.

perature it refuses to change in resistance, the curve having become practically asymptotic to the axis of temperature? On the other hand, has the influx of heat by the leads, and the correction on account of this change of resistance, become so great as to vitiate the results at these excessively low temperatures? Again, it may be suggested that the thermometer was not properly cooled, or that the liquid hydrogen does not lower in temperature to any marked extent under exhaustion like other liquids. All these conjectures can only be set at rest by a repetition of the experiments with a new thermometer of much higher initial resistance and under conditions of better heat isolation. No blunder having been detected in the observations, for the present we must assume that the platinum resistance thermometer No. 7 acts in the manner described. It would be premature to discuss the inferences to be drawn from these results until they are confirmed on another variety of platinum wire made into a resistance thermometer. But as this will involve the use of considerable quantities of liquid hydrogen, it will take some time to complete the investigation.

The same kind of anomaly appears in the case of the use of a thermojunction at these low temperatures, but this is a separate matter, and must be dealt with in a further communication.

I am indebted to Mr. J. E. Petavel for assistance in the electrical measurements, and also to Mr. Robert Lennox and Mr. Heath for their general help in the conduct of the experiments.

WIRELESS TELEGRAPHY.*

By G. MARCONI.

"WIRELESS telegraphy," or telegraphy through space without connecting wires, is a subject which has attracted considerable attention since the results of the first experiments I carried out in this country became known. It is not my intention this evening to give my views on or discuss the theory of the system, with which I have carried out so many experiments, and by means of which I have worked various installations, but I hope to put before you some exact information of what has been done by myself and my assistants during the last twelve months, and also some reliable data as to the means employed to obtain such results. Much has been published on the subject, I must say with varying accuracy, and there can hardly be any one here altogether ignorant of the general characteristics of the system. Before I go into this subject further I wish to state that any success I have met with in the practical application of wireless telegraphy has been in a large measure due to the efficient co-operation which has been rendered by my assistants. I think it will not be out of place if I give a brief description of the apparatus.

Transmitter.—When long distances are to be bridged over and it is not necessary that the signals should be sent in one definite direction, I employ as transmitter an arrangement as shown in Fig. 1, in which two small spheres connected to the terminals of the secondary winding of an induction coil, *c*, are connected, one to earth and the other to a vertical conductor, *w*, which I will call the aerial conductor. Should it be necessary to direct a beam of rays in one given direction, I prefer to use an arrangement similar to a Righi oscillator placed in the focal line of a suitable cylindrical parabolic reflector, *f*, Fig. 5. The transmitter works as follows: When the key, *b*, is pressed, the current of the battery is allowed to actuate the spark coil, *c*, which charges the spheres of the Righi oscillator or the vertical wire, *w*, which discharges through the spark gap. This discharge is an oscillating one, and the system of spheres and insulated conductor becomes a radiator of electric waves. It is easy to understand how, by pressing the key for long or short intervals, it is possible to emit a long or short succession of waves, which, when they influence the receiver, reproduce on it a long or short effect, according to their duration, in this way reproducing the Morse or other signals transmitted from the sending station.

Receiver.—One of the principal parts in my receiver is the sensitive tube or coherer or radio-conductor, which was discovered, I think I am right in saying, by Prof. Calzecchi Onesti, of Fermo,† and was improved by Branly, and modified by Prof. Lodge and others. The only form of coherer I have found to be trustworthy and reliable for long distance work is one designed by myself as shown in Fig. 2. It consists of a small glass tube, four centimeters long, into which two metal pole pieces, *j' j'*, are tightly fitted. They are separated from each other by a small gap, which is partly filled with a mixture of nickel and silver filings. This coherer forms part of a circuit containing the local cell and a sensitive telegraph relay actuating another circuit, which circuit works a trembler, *p*, or decoherer and a recording instrument, *h*. In its normal condition the resistance of the filings in the tube, *j*, is infinite, or at least very great, but when the filings are influenced by electric waves or surgings, cohesion instantly takes place, and the tube becomes a comparatively good conductor, its resistance falling to between 100 and 500 ohms. This allows the current from the local cell, *g*, to actuate the relay, *n*. One end of the tube is connected to earth and the other to a vertical conductor similar to that of the transmitter, Fig. 1, or, if reflectors are used, a short strip of copper is connected to each end, Fig. 4. The length of these strips of copper must be carefully determined, as good results cannot be obtained unless they happen to be of the proper length, which will cause them to be in tune or syntony with the transmitted oscillations. All the electromagnetic apparatus in the receiver is shunted by non-inductive resistances in such a manner that there may be no sparking at contacts and no sudden perturbations or jerks caused by the local battery current near the coherer. I find that the relay tapper and telegraphic instrument, if not properly shunted, produce disturbing effects, the result of which is to prevent the coherer from regaining its sensitive condition after the receipt of electrical oscillations. No such trouble is experienced when suitable shunts are used, and I attribute to their action in very great measure the success which has been attained with this system. Small choking coils, *k' k'*, are introduced between the coherer and the relay. They compel the oscillating current due to the electric waves to traverse the coherer rather than waste its energy in the alternative path afforded by the relay. The oscillations induced on the strips, *k k*, or aerial conductor, *w*, which acts as resonator, by the radiation from the oscillator affect the sensitive tube. This effect on the tube consists, as we have said, in a great increase of its conductivity, thus completing the circuit and allowing the current from the cell to actuate the relay. The relay in its turn causes a larger battery, *r*, to pass a current through the tapper or interrupter, *p*, and also through the electromagnets of the recording instrument, *h*.

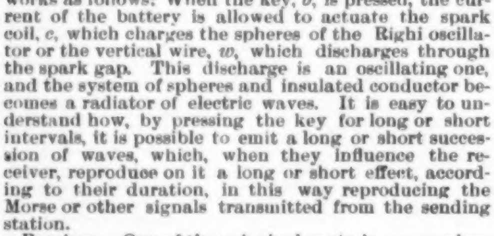


FIG. 1.

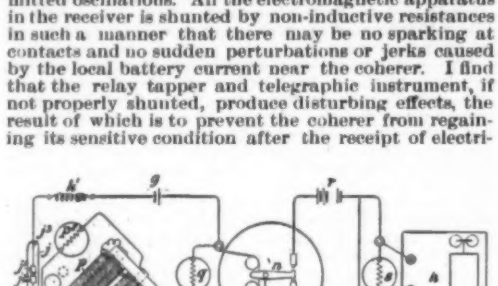


FIG. 2.

The tapper or trembler is so adjusted as to tap the tube and shake the filings in it. If in the instant during which these various actions take place, the electrical oscillations had died out in the resonator, the shake or tap given to the tube by the hammer, *o*, would have restored it to its normal high-resistance condition, and the Morse instrument or recorder would have marked a dot on the tape; but if the oscillations continue at very brief intervals the acquired conductivity of the tube, *j*, is destroyed only for an instant by the tap of the trembler, and immediately re-established by the electrical surgings; and, therefore, the relay tapper and telegraph instrument are again actuated, and so on until the oscillations from the radiator have ceased. The practical result is that the receiver is actuated for a time equal to that during which the key is pressed at the transmitting station. For each signal, however short, the armatures of the relay and tapper perform some very rapid vibrations dependent on each other. For it is the action of the relay which starts the tapper, but the tapper by its action interrupts the relay. The armature of the Morse recording instrument being rather heavy, and possessing a comparatively large inertia, cannot follow the very rapid vibrations of the tongue of the relay, but remains down all the time during which the rapidly intermittent action of the receiver lasts. In this way the armature of the inker gives a practically exact reproduction of the movements of the key at the transmitting end, dashes coming out as dashes and dots as dots.

Much has been said and written about coherers being very unreliable and untrustworthy in their action, but I must confess that this has not been in any way my experience. Provided a coherer is properly constructed and used on a suitable receiver, it is just as certain in its action as any other electrical apparatus, such as an electromagnet or incandescent lamp. I have coherers which were made three years ago that are now quite as good if not better than they were at that time, and we have had tubes working for months in most important installations without ever giving trouble. At the installation my company have erected at the South Foreland Lighthouse, which, as you probably know, is working to the East Goodwin Lightship, the coherer was mounted on the receiver when we first started in December of last year, and has done its work in a most satisfactory manner ever since. I must call you attention to the object and function of the vertical wire, *w*. It has been by means of this addition to the apparatus that we have been able to telegraph over distances which have been so far unattained, I think I am right in saying, by any other method of space telegraphy. The way I came to appreciate the great importance of the addition of the conductor, *w*, and earth connection, *E*, to the apparatus was as follows: (I take this data from a copy of a letter I wrote to Mr. Preece in November, 1896.) When carrying out some experiments in Italy in 1895, I was using an oscillator having one pole earthed and the other connected to an insulated capacity, the receiver also earthed and connected to a similar capacity. The capacities were in this case cubes of tinned iron of 30 centimeters side, and I found that when these were placed on the top of a pole 2 meters high, signals could be obtained at 30 meters from the transmitter. With the same cubes on poles 4 meters high, signals were obtained at 100 meters, and with the same cubes at a height of 8 meters, other conditions being equal, Morse signals were easily obtained at 400 meters. With larger cubes of 100 centimeters side, fixed at a height of 8 meters, reliable signals could be obtained at 2,400 meters all round, equal to about one mile and a half. These results seemed to point out that a system of transmitter and receiver designed according to the lines on Fig. 1, *i. e.*, a radiator of the Hertzian type having one pole earthed and the other connected to a vertical, or almost vertical, conductor, or to a lofty capacity area, and a resonator consisting of a suitable receiver having similarly one terminal connected to earth and the other to an insulated vertical conductor, constitute a system of transmitter and receiver capable of giving effects at far greater distances than the ordinary systems of Hertzian radiators and resonators. The results I have referred to also show that the distance at which signals could be obtained varied approximately with the square of the distance of the capacities from earth, or perhaps with the square of the length of the vertical conductors. This law has since been verified by a careful series of experiments and found correct, and has furnished us with a sure and safe means of calculating what length the vertical wire should be in order to obtain results at a given distance. It is well to know that the said law has never failed to give the expected results across clear space in any installation or experiment I have carried out, although it usually seems that the distance obtained is slightly in excess of what one might expect. I find that with parity of other conditions a vertical wire 20 feet long at the transmitter and receiver is sufficient for communicating one mile, 40 feet at each end for 4 miles, and 80 feet for 16 miles and so on. An installation is now working over a distance of 18 miles with a vertical wire 80 feet high at each installation station.

Prof. Ascoli* has confirmed this, and demonstrated mathematically, using Neumann's formula, that the inductive action is proportional to the square of the length of one of the two conductors if the two are vertical and of equal length, and in simple inverse proportion of the distance between them. Therefore, the intensity of the induced oscillation does not diminish with the increase of distance if the length of the vertical conductors is increased in proportion with the square root of the distance—that is, if the height of the wire is double, the possible distance becomes quadrupled. Should it be necessary to rig up an installation at a distance of say 32 miles, such as is about the distance between Folkestone and Boulogne, it is easy to find that a vertical wire 114 feet long would be quite sufficient for that purpose.

Such laws are applicable only when apparatus properly constructed is employed. With apparatus in which some or several improved details are omitted, I find it quite impossible to obtain anything like the results above mentioned. If, say, the impedance coils, *k″ k″*, are omitted, the distance (other conditions being equal) is reduced to almost half its original value. I must also call your attention to such cases as when obstacles like hills or mountains, or large metallic objects, happen to intervene between the places between which it is desired to establish communication. With all other forms of Hertzian transmitters and receivers with which I have experimented I find it to be quite impossible to obtain any results if a hill, mountain, or large metallic object intervenes in any way between the two stations. I am not aware whether any satisfactory results have been obtained by others where such obstacles have intervened, but when the vertical wire system is employed it becomes easy to telegraph between positions screened from each other by hills or by the curvature of the earth. In such cases it seems to be a marked advantage if the aerial conductor is thick or if a capacity area is placed at the top of it. I am rather doubtful as to the correct explanation that can be given to this effect. I think there can be very little doubt as to the complete opacity, to electric waves, of a hill three miles thick, or of say several miles of sea water. A solution of this difficulty might be given by attributing the results to the effect of the diffraction of such long waves as those radiated by a conductor 100 feet long, but in that case it is difficult to explain why other forms of Hertzian transmitters and receivers, also giving long waves, do not act when such obstacles intervene. A way out of the difficulty may be arrived at if we suppose that the electrical oscillations are transmitted to the earth by the earth wire, *E*, of the transmitter and travel in all directions along the surface of the earth till they reach the earth wire of the receiving instrument, and by traveling up

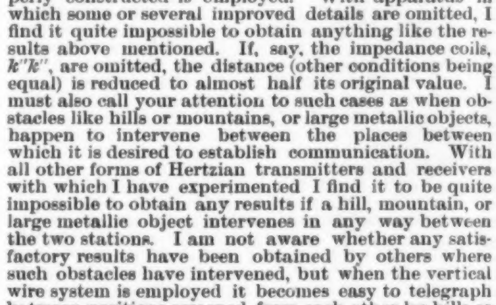


FIG. 3.

the said wire to the coherer thus bring about its action. This was the first explanation I came to during my early experiments. I, however, do not wish to say that I hold entirely to this view at present, although I have not yet found any other perfectly satisfactory explanation of the phenomena. It is well, also, to note that a horizontal wire, even if supported at a considerable height from earth, seems to be of little or no practical utility in increasing the range of signals. If, say, a vertical wire 30 feet long is employed at both stations, and to the top of this is added a horizontal length of 300 feet, as shown in Fig. 6, the distance obtained is greater with the vertical wire without the horizontal length than it would be if both were employed. These results show that with this system it is not sufficient to use a horizontal radiating or collecting wire, as such a wire would be of no utility for long-distance signaling.

I believe that the exceedingly marked advance in the by the adoption of the vertical conductor is due to the

* Paper read before the Institution of Electrical Engineers.

† See Nuovo Cimento, Series 3, vol. xvii., Jan.—Feb., 1885; and ditto, Jan.—Feb., 1886.

* See Elettricista, August number, 1897. (Ro-

fact that the plane of polarization of the rays radiated is vertical, and that, therefore, they are not absorbed by the surface of the earth, which acts as a receiving conductor placed horizontally. As the maximum effect is obtainable when the conductors of the transmitter and receiver are parallel, this makes it necessary to have a vertical conductor connected to one pole of the coherer.

Before proceeding to describe the results obtained under various conditions by means of what we may call the vertical wire system, I think it desirable to bring before you some observations and results I have obtained with a system of Hertzian wave telegraphy, which was the first with which I worked, and in which parabolic reflectors are used to control the propagation and intensify the effects obtained when comparatively short electric waves are employed for signaling. As in ordinary optics, so also in the optics of electromagnetic oscillations, it is possible, as has been shown by Hertz, to reflect the waves radiated from the oscillator in one definite direction only. This can be done, as you know, by using convenient reflectors, similar to those used for projectors, but preferably, for economical reasons, made of copper or zinc, instead of silver amalgam or silver. Except when very small radiators of the Righi or Lebedew type are employed, it is desirable to use cylindrical parabolic reflectors, and it is with reflectors such as I here exhibit that the trials to which I am alluding have been carried out. The advantages obtainable by their use are obvious.

In any other system intended for the transmission of telegraphic signals by means of electric waves through space, the waves have been allowed to radiate in all directions, and would affect all suitable receivers within a certain radius, which, of course, is dependent on the power of the radiator or transmitter and on the sensitiveness of the resonator or receiver. It is, however, possible, by means of syntonizing arrangements, to prevent, to a certain extent, messages affecting instruments or receivers for which they are not intended, and therefore to select any receiver by altering the wave length of the transmitter. By means of reflectors it is possible to project the waves in one almost parallel beam which will not affect any receiver placed out of its line of propagation, whether the said receiver is or is not in tune or syntony with the oscillation transmitted. This would enable several forts, or hill-tops, or islands to communicate with each other without any fear of the enemy tapping or interfering with the signals, for if the forts are on small heights the beam of rays would pass above the positions which might be occupied by the enemy. An illustration of the possibility of directing these waves can be shown by the action of the receiver, which in this case rings a bell only when the radiator in the reflector is directed toward it. These results are much more marked in an open space than in a lecture theater, as the walls, gilt hangings, etc., tend to reflect the rays in all directions and may alter the results.

In experiments carried out over a distance of 1¾ miles, I noticed that only a very small movement of the transmitting reflector was sufficient to stop the signals at the receiving end, which could be only obtained within a latitude of 50 feet to the right or left of what was believed to be the center of the beam of reflected radiations. There exists a most important case to which the reflector system is applicable, namely, to enable ships to be warned by lighthouses, light-vessels, or other ships, not only of their proximity to danger, but also of the direction from which the warning comes. If we imagine that *A* is a lighthouse provided with a transmitter of electric waves, constantly giving a series of intermittent impulses or flashes, and *B* a ship provided with a receiving apparatus placed in the focal line of a reflector, it is plain that when the receiver is within range of the oscillator the bell will be rung only when the reflector is directed toward the transmitter, and will not ring when the reflector is not directed toward it. If the reflector is caused to revolve by clockwork or by hand, it will therefore give warning only when occupying a certain sector of the circle in which it revolves. It is therefore easy for a ship in a fog to make out the exact direction of point, *A*, whereby, by the conventional number of taps or rings, she will be able to discern either a dangerous point to be avoided or the port or harbor for which she is endeavoring to steer. I have not up to the present attempted to signal any greater distance than

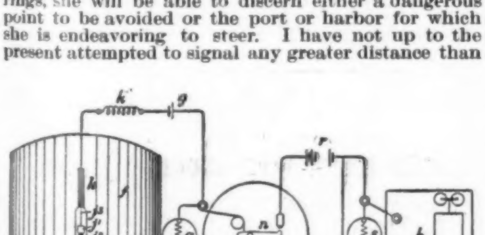


FIG. 4.

about two miles with reflectors, but I am of opinion that across clear space it will be quite possible to obtain satisfactory results at far greater distances, especially if the reflectors are accurately made any larger than those I have used. By means of the same apparatus exhibited here I have succeeded in signaling over a distance of 2½ miles, without, of course, the use of any real "base" lines, which were supposed to be essential for any distance greater than a few feet. It was by means of reflectors I obtained the results over 1¾ miles mentioned by Mr. Preece at the British Association meeting of 1896. I have, however, dedicated more time to the other system, *i. e.*, the vertical wire system.

A station at Alum Bay, Isle of Wight, and another at Bournemouth, the distance between them being 14½ miles, were erected at the beginning of last year, in order to test the practicability of the system under all conditions of weather, and also to afford an opportunity of proving that "wireless telegraphy" was not a myth but a working reality. I believe some details of the special conditions of these stations would be of interest. The installation at Alum Bay is in the Needles Hotel, and the Bournemouth station (which has lately been transferred to the Haven Hotel, Poole, thereby increasing the distance to 18 miles), was at Madeira House, South Cliff. At each station a pole 120 feet high was used, which supported the aerial conductor, usually a stranded conductor of 7/20 copper wire insulated with rubber and tape. A 10 inch induction coil is used at each station, worked by a battery of 100 Obach cells "M" size, the current taken by the coil being at 14 volts from 6 to 9 amperes. The spark discharge takes place between two small spheres about 1 inch in diameter, this form of transmitter having been found more simple and more effective than the Righi oscillator I had previously used. The length of the spark is adjusted to about 1 centimeter. This, being a much shorter spark than the coil can give, allows a

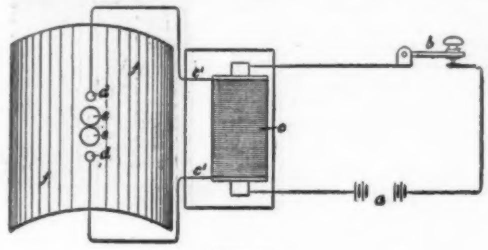


FIG. 5.

good margin over for any irregularity that might be caused by the break. No care is ever taken to polish the spheres, *d d*, at the place where the spark occurs, as the results seem decidedly better with dull spheres than with polished ones. The first tests were made between the Isle of Wight and a steamer, the height of the mast on the boat being about 60 feet. Readable signals were obtained up to a distance of 18 miles from Alum Bay. During the course of these experiments I had the pleasure of the company and assistance of Capt. Kennedy, R.E., who was good enough to draw a map showing the course of the steamer. It has apparently been thought that weather or varying conditions of atmospheric electricity may interfere with or stop the signals transmitted by this system, but experience of over 14 months of continual everyday work has brought me to the conclusion that there is no kind of weather which can stop or seriously interfere with the working of such an installation. We have given demonstrations to several eminent scientists, who came down and wanted a show, often when we did not expect them, but on no occasion have they found any difficulty in the work of transmitting and receiving messages between the two stations.

In September of last year, in consequence of the expiration of our lease at Madeira House, Bournemouth, we transferred that station, as I have said, to the Haven Hotel, Poole, thereby increasing the distance to 18 miles. Experiments and tests are carried out daily between the two stations, the improvement in apparatus having allowed us to reduce the height to 80 feet at each end. An average of fully 1,000 words are daily transmitted through the ether each way. In the spring of last year Lord Kelvin inspected our station at Alum Bay, and he was kind enough to express himself as highly pleased with what he saw. He sent several telegrams to his friends, including Mr. Preece and Sir George Stokes, and insisted on paying 1s. royalty on each message, wishing in this way to show his appreciation of what was done, and to illustrate its fitness at that time for commercial use. We are now working at experiments directed toward still further reducing the height necessary for a given distance, and also a good deal on syntonic systems. In May of last year Lloyds desired to have an illustration of the possibility of signaling between Ballycastle and Rathlin Island, in the north of Ireland. My assistants, Mr. Kemp and the late Mr. Glanville, installed the instruments at Ballycastle and at Rathlin Island. The distance between the two positions is 7½ miles, of which about 4 are overland and the remainder across the sea, a high cliff also intervening between the two positions. At Ballycastle a pole 70 feet high was used to support the wire, and at Rathlin a vertical conductor was supported by the lighthouse 80 feet high. Signaling was found quite possible between the two points, but it was thought desirable to bring the height of the pole at Ballycastle to 100 feet, as the proximity of the lighthouse to the wire at Rathlin seemed to diminish the effectiveness of that station. At Rathlin we found that the lighthouse keepers were not long in learning how to work the instruments, and, after the sad accident which happened to poor Mr. Glanville, that installation was worked by them alone, there being no expert on the island at the time. Following this, in July we were requested by a Dublin paper, The Daily Express, to report from the high seas the results and incidents of the Kingstown Regatta. In order to do this we erected a land station, by the kind permission of the harbormaster at Kingstown, in his grounds, where a pole 110 feet high was placed. A steamer, the "Flying Huntress," was chartered to follow the racing yachts, the instruments being placed in the cabin. The height of the vertical wire attainable by the mast was 75 feet. A telephone was fixed from our land station at Kingstown to The Express office in Dublin, and as the messages came from the ship they were telephoned to Dublin, and published in succeeding editions of the evening papers. The relative positions of the various yachts were thus wirelessly signaled while the races were in progress, sometimes over a distance of ten miles, and were published long before the yachts had returned to harbor. During the several days the system was in use between the tug and the land station over 700 messages were sent and received, none requiring to be repeated. On trying longer distances it was found that with a height of 80 feet on the ship and the same height as already stated on land, it was possible to communicate up to a distance of 25 miles, and it is worthy of note in this case that the curvature of the earth intervened very considerably at such a distance between the two positions. On one occasion, on a regatta day, I had the pleasure of the company of Prof. G. F. Fitzgerald, of Trinity College, Dublin, on the ship, who, as would be expected, took a very great interest in the proceedings.

Immediately after finishing at Kingstown I had the honor of being asked to install wireless telegraph communication between the royal yacht "Osborne" and Osborne House, Isle of Wight, in order that her Majesty might communicate with H. R. H. the Prince of Wales, from Osborne House, to the royal yacht in Cowes Bay, and during the trips his Royal Highness frequently took. The working of this installation was a very pleasant experience for me, and it afforded, also, an opportunity of more thoroughly studying the effect of intervening hills. In this installation induction coils capable of giving a 10 inch spark were used at both stations. The height of the pole supporting the vertical conductor was 100 feet at Osborne House. On the royal yacht "Osborne" the top of our conductor was suspended to the mainmast at a height of 83 feet from the deck, the conductor being very near one of the funnels, and in the proximity of a great number of wire stays. The vertical conductor consisted of a 7/20 stranded wire at each station. The royal yacht was moored in Cowes Bay at a distance of 1¾ miles from Osborne House, the two positions not being in sight of each other, the hills behind East Cowes intervening. This circumstance would have rendered direct signaling between the two positions impossible by means of any flag, semaphore, or heliograph system. Constant and uninterrupted communication was maintained between the royal yacht and Osborne House during the 16 days the system was in use, no hitch whatever occurring. One hundred and fifty messages were sent, being chiefly private communications between the Queen and the Prince. Many of these messages contained over 150 words, and the average speed of transmission was about 15 words per minute. By kind permission of the Prince of Wales I will now read to you some of the telegrams which passed between the royal yacht and Osborne House:

August 4.

FROM DR. FRIPP TO SIR JAMES REID.

H. R. H. the Prince of Wales has passed another excellent night, and is in very good spirits and health. The knee is most satisfactory.

August 5.

FROM DR. FRIPP TO SIR JAMES REID.

H. R. H. the Prince of Wales has passed another excellent night and the knee is in good condition.

The following telegram was sent during a cruise, and while the royal yacht was under way, as you will see from the context:

August 10.

FROM H. R. H. THE PRINCE OF WALES TO DUKE OF CONNAUGHT.

Will be very pleased to see you on board any time this afternoon when the "Osborne" returns.

This telegram was sent when the yacht was off Bembridge, at a distance of about seven or eight miles from Osborne. On August 12th the "Osborne" steamed to the Needles, and communication was kept up with Osborne House until off Newton Bay, a distance of seven miles, the two positions being completely screened from each other (even to the tops of the masts) by the hills lying between. At the same position we found it quite possible to speak with our station at Alum Bay, although Headon Hill, Golden Hill, and over five miles of land lay directly between. The positions were eight and a half miles apart. Headon Hill was 45 feet higher than the top of our conductor at Alum Bay station, and 314 feet higher than the vertical wire on the "Osborne." The yacht on the same trip proceeded till about three miles past the Needles, communication having been maintained during the whole trip. Another day, when I did not happen to be on board, the yacht went on a cruise round Bembridge and Sandown, communication being maintained with Osborne House, although more than eight miles of land lay between the two positions. The Prince of Wales and other members of the royal family, the Duke of York, made much use of the system, and expressed themselves as highly satisfied with its practicability. I consider these results rather interesting, as doubts have been expressed by some as to whether it would be possible by this system to telegraph over long stretches of land. Results across hills were also obtained near Spezia by officers of the Italian navy, using my system.

In December of last year my company thought it

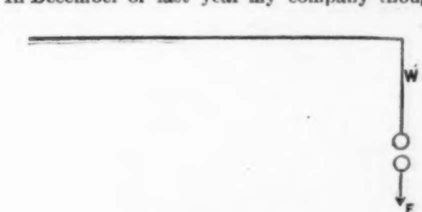


FIG. 6.

desirable to demonstrate that the system was quite practical and available for enabling telegraphic communication to be established and maintained between lightships and the shore. This, as you are probably aware, is a matter of much importance, as all other systems tried so far have failed, and the cables, by which some three or four ships are sometimes connected, are exceedingly expensive, and require special moorings and fittings, which are troublesome to maintain and liable to break in storms.

The officials of Trinity House offered us the opportunity of demonstrating to them the utility of the system between the South Foreland Lighthouse and one of the following light-vessels, viz., the "Gull," the "South Goodwin," and the "East Goodwin." We naturally chose the one furthest away—the "East Goodwin"—which is just 12 miles from the South Foreland Lighthouse. The apparatus was taken on board in an open boat, and rigged up in one afternoon. The installation started working from the very

first without the slightest difficulty. The system has continued to work admirably through all the storms, which during this year have been remarkable for their continuance and severity.

On one occasion, during a big gale in January, a very heavy sea struck the ship, carrying part of her bulwarks away. The report of this mishap was promptly telegraphed to the superintendent of Trinity House, with all details of the damage sustained. The height of the wire on board the ship is 80 feet, the mast being for 60 feet of its length of iron and the remainder of wood. The aerial wire is let down among a great number of metal stays and chains, which do not appear to have any detrimental effect on the strength of the signals. The instruments are placed in the aft-cabin, and the aerial wire comes through the framework of a skylight from which it is insulated by means of a rubber pipe. As usual, a 10 inch coil is used, worked by a battery of dry cells, the current taken being about 6 to 8 amperes at 14 volts. Various members of the crew learned in two days how to send and receive, and in fact how to run the station, and owing to the assistant on board not being as good a sailor as the instruments have proved to be, nearly all the messages during very bad weather are sent and received by these men, who, previous to our visit to the ship, had probably scarcely heard of wireless telegraphy, and were certainly unacquainted with even the rudiments of electricity. It is remarkable that wireless telegraphy, which had been considered by some as rather uncertain, or that might work one day and not the next, has proved in this case to be more reliable, even under such unfavorable conditions, than the ordinary land wires, very many of which were broken down in the storms of last month. The instruments at the South Foreland Lighthouse are similar to those used on the ship, but as we contemplate making some long distance tests from the South Foreland to the coast of France, the height of the pole is much greater than would be necessary for the lightship installation. We found that 80 feet of height is quite sufficient for speaking to the ship, but I am of opinion that the height available on the ship and on shore would be ample even if the distance to which messages had to be sent were more than double what it is at present. Service messages are constantly passing between the ship and the lighthouse, and the officials of Trinity House have been good enough to give expression of their entire satisfaction with the result of this installation. The men on board send numerous messages almost daily on their own private affairs; and this naturally tends to make their isolated life less irksome.

My company has been anxious for some time to establish wireless communication between England and France across the Channel, in order that our French neighbors might also have an opportunity of testing for themselves the practicability of the system, but the promised official consent of the French government has only been received this evening. Otherwise this communication would have been established long ago. The positions for the stations chosen were situated at Folkestone and Boulogne, the distance between them being 32 miles. I prefer these positions to Calais and Dover, as the latter are only separated by a distance of about 20 miles, which is only slightly more than we are doing every day at Poole and Alum Bay, and as we find that distance so easy, we would naturally prefer further tests to be made at much greater distances. We did ask for permission to erect a station at Cherbourg, the corresponding station to be at the Isle of Wight, but the French authorities stated that they would prefer us to have our station in that country in some other position on the north coast.

My system has been in use in the Italian navy for more than a year, but I am not at liberty to give many details of what is done there. Various installations have been erected and are working along the coast, two of these being at Spezia. Distances of 19 miles have been bridged over in communicating with war vessels, although 10 miles have been found quite sufficient for the ordinary fleet requirements. Other installations are now contemplated in this country for commercial and military purposes, and I am confident that in a few months many more wireless telegraph stations will be established both here and abroad.

In Der Amateur Photograph for November Dr. Walter Hoffmann introduces the subject of stereoscopic photographs of cloud forms, by remarking that this class of work has both scientific and artistic interest. Obviously, in order to obtain stereoscopic representations of clouds, the separation of the two lenses must be very considerable—from 50 to 300 meters, according to the height of the clouds; and obviously two separate cameras are required. The simplest way is for the two persons in charge to agree by signal or otherwise as to which mass of clouds is to be centered on the focusing screens, and for exposures to be made simultaneously by signal (a motion of the hand); although in some cases, as when measurements of the exact height of the clouds is desired, it may be convenient to effect a simultaneous exposure by an electric device for releasing the shutters; indeed, this has been the usual method among photo meteorologists. Short exposures are necessary, as clouds sometimes move quickly, but a yellow screen is generally desirable. The author comments on the beauty of cloud forms when seen stereoscopically; but his suggestion that stereoscopic sky should be added to landscape stereograms is certainly open to the objection of incongruity, as the sky would show more stereoscopic effect than the corresponding distance in the landscape.

An exchange notes that the present year marks the centenary of the discovery of beet root sugar, which was announced by Franz Karl Achard, the director of the Prussian Academy, to Frederick William II., on January 11, 1799. Extensive experiments were immediately ordered by the king. It is said that 200,000 thalers were offered by the proprietors of the sugar plantations in the West Indies for the suppression of the discovery. At that time the output of sugar amounted to only 200,000 tons a year.

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